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TECHNICAL MANUAL

GROUND SERVICING OF AIRCRAFT
AND
STATIC GROUNDING / BONDING

(ATOS)

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SECTION I

INTRODUCTION

1-1. **PURPOSE.**

1-2. This technical order provides guidance to help minimize injury and property damage mishaps associated with aircraft ground servicing operations and other allied support functions accomplished concurrently with ground servicing. Additionally, this technical order provides information on the nature of electrical hazards and means of minimizing electricity problems associated with servicing operations.

1-3. **SCOPE.**

1-4. This technical order applies to all USAF aircraft ground servicing operations as well as servicing of non-USAF aircraft when performed at USAF or non-USAF installations by USAF personnel, or under USAF control. Excluded is the servicing of air launched missiles and stores. Procedures for requesting waivers to this technical order (and all other technical orders) are covered in AFI 91-301. HQ USAF/ LGMM/LGSSF approves all waivers and assigns control numbers. Corrections regarding this technical order should be submitted in accordance with TO 00-5-1.

1-5. **RESPONSIBILITIES.**

1-6. Commanders, managers, and supervisors shall insure that all aircraft servicing personnel under their supervision are knowledgeable and proficient on pertinent publications and technical orders and exercise safe practices during ground operations.

1-7. **DEFINITIONS.**

1-8. Please note the following in regards to the text of this technical order.

Shall and Will - Indicate mandatory requirements. Will is also used to express a declaration of purpose.

Should - Indicates a preferred method of accomplishment.

May - Indicates an acceptable or suggested means of accomplishment.

WARNING

Operating procedures or practices which, if not correctly followed, could result in personnel injury or loss of life.

CAUTION

Operating procedures or practices which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

Operating procedures or conditions which are essential to highlight.

a. Aircraft Fuel Servicing: The movement of fuel to or from an external source to or from an aircraft, including the time during which fueling connections and disconnections are made (bond wires and nozzles). Also, checks are made of fuel quantity and any spilled fuel is cleaned up or neutralized.

b. Aircraft Servicing Supervisor: The person responsible for the aircraft fuel servicing operations. The individual shall be task trained and certified as required by the Career Field Education and Training Plan (CFETP) and any other MAJCOM or local maintenance/training directives.

c. Bonding: Electrically connecting two or more components of a system to equalize voltage potential.

d. Cathodic Protection: A means of protecting metals from corrosion by making the metal the cathode of an electrolytic cell. Pipelines, tanks, and steel piers (wharves) are often protected in this manner.

e. Chief Servicing Supervisor: The person responsible for on-site supervision of all aspects of concurrent fuel servicing operations. The individual shall be task trained and certified as required by the Career Field Education and Training Plan (CFETP) and any other MAJCOM or local maintenance/training directives.

f. Concurrent Servicing: The simultaneous servicing of fuel or oxygen with either passengers on board or the performance of minor maintenance, fleet servicing, or baggage or cargo loading/ unloading.

g. Concurrent Servicing Area: The area within an imaginary circle around the aircraft that includes the fuel servicing safety zones and extends at least 10 feet outboard of the aircraft wingtips, tail, and nose.

h. Deadman Control: An electrically, hydraulically, mechanically, or pneumatically operated switch or valve requiring continuous positive hand pressure by the operator to maintain fuel flow. Releasing the positive hand pressure stops fuel flow.

i. Defueling: The movement of fuel from an aircraft to an external source.

j. Flashpoint: The lowest temperature at which vapors arising from fuel will ignite (momentarily flash) on application of a flame or spark.

k. Deleted

l. Fuel Servicing Hose:

(1) Soft (collapsible) - Rubber hose conforming to MIL-H-26521, flexible, capable of being completely flattened and coiled for ease of storage and handling.

(2) Semi-hard (noncollapsible) - Rubber hose conforming to MIL-H-6615 and MIL-H-370, braided, loomed, or plied reinforcement, not capable of being coiled easily.

(3) Hard (noncollapsible) - Rubber hose conforming to MIL-H-27516 and MIL-H-26894, braided, loomed, or plied reinforcement with a steel spiral wire wound between reinforcing members.

m. Fuel Servicing Safety Zone (FSSZ): The area within 50 feet of a pressurized fuel carrying servicing component, i.e., servicing hose, fuel nozzle, single-point receptacle (SPR), hydrant hose cart, ramp hydrant connection point, etc., and 25 feet around aircraft fuel vent outlets.

n. Fuel Servicing Vehicle: A mobile self propelled vehicle designed with a power take-off and filter separator to transport, receive, and dispense fuel. The most common type of fuel servicing unit in the Air Force inventory is R-11.

o. Fuel Spill: Dripping, splashing or overflow of fuel. The fuel spill classifications are:

(1) Class I spills involve an area less than two feet in any plane dimension (direction). Using agency fireguards, determine if these spills create a fire hazard to the aircraft or equipment. Generally, these spills need only be monitored until the aircraft is dispatched.

(2) Class II spills involve an area not over 10 feet in any plane dimension (direction), or not over 50 square feet and not of a continuing nature. Post the area, using agency fireguards, and immediately notify the fire protection organization and the base agency responsible for cleanup of hazardous spills.

(3) Class III spills involve an area over 10 feet in any plane dimension (direction) or over 50 square feet in total area or of a continuing nature. Post the area, using agency fireguards, and immediately notify the fire protection organization and the base agency responsible for cleanup of hazardous spills. These conditions shall be considered a ramp mishap (accident or incident). The senior fire official will respond with the personnel, vehicle(s) and equipment necessary to control and contain the hazardous condition until the local/base agency responsible for cleanup can properly dispose of the hazardous material(s).

p. Grounding (electrostatic): A path or means to remove any electrostatic charge buildup on a conductive object by connecting that conductive object to earth.

q. Hose Cart (MH-2 Series): A trailer-mounted unit containing a filter separator, meter, hoses, and nozzles for connecting the hydrant outlet to the aircraft. It may be used with the Type II system or Type I modified system. It may be equipped with a Y-adapter to permit refueling two aircraft at the same time. It may also be used to refuel commercial aircraft requiring simultaneous servicing into both wings.

r. Hot Integrated Combat Turnaround: A simultaneous fuel servicing and either munitions loading/unloading, external fuel tank loading/unloading, or other specified maintenance activity with one or more aircraft engine operating.

s. Hot Pad Refueling Supervisor: A person (five-level or higher) with overall supervisory responsibility for simultaneous hot refueling operations.

t. Hot Refueling/Defueling: The transfer of fuel into or out of the fuel tanks of an aircraft with one or more aircraft engine operating.

u. Hot Refueling/Defueling Area: The area within 50 feet of a hot refueling/defueling operation.

v. Hydrant Hose Truck: A self-propelled aircraft fuel servicing unit capable of dispensing up to 1200 GPM, equipped with inlet and discharge hoses, meter, filter/separator, various pressure and flow control valves, and safety devices.

w. Hydrant Operator: A person (AFSC 2F0X1) who activates electrical and/or magnetic switches and valves necessary for fuel to flow from the hydrant system to the aircraft on the Type I, Type II, Type III, and Type IV hydrant systems. Operates hydrant hose truck, hose cart, or pantograph. The Type IV operator is positioned at the control pit, maintains visual contact with all crew

members, monitors pressure gauges and the meter in the hydrant pit, and, in an emergency or upon signal from the aircraft refueling or pad refueling supervisor, activates the emergency electrical shutdown switch and the fire suppression system.

x. Hydrant Outlet: A fueling valve located on the parking ramp where the fuel hose or hose cart is connected.

y. Integrated Combat Turnaround: A simultaneous fuel servicing and either munitions loading/unloading, external fuel tank loading/unloading, or other specified maintenance activity with all aircraft engines shut down.

z. Intrinsically Safe Radio: A radio which is incapable of causing ignition of a mixture of flammable or combustible material in the air in its most easily ignitable concentration. This radio is suitable for use in Class I, Division 1, Group D hazardous areas in which fuel vapors exist. The radio must contain a logo (decal/metallic label) reflecting compliance with NFPA 70 for use in Class I, Division 1 locations. Radios built according to Military Standard 810 meet the intrinsic safe requirements of NFPA 70.

aa. Lateral Control Pit: An area below ground level adjacent to the parking ramp containing components of the hydrant system and controlling one or more hydrant outlets.

ab. Lateral Control Pit Switch: An on/off explosion proof switch, usually located at the hydrant control pit. It may be either a pushbutton on/off or a selector on/off to energize a remote control switch. Some control pits may have both types.

ac. Lateral Control Pit Emergency Switch: A switch located at the control pit which overrides all other on/off switches and shuts down the entire hydrant system. Type II hydrant systems also have an emergency switch at each outlet.

ad. Liquid Oxygen (LOX) Servicing Safety Zone: The area within 20 feet of pressurized LOX servicing equipment, servicing hose, aircraft servicing connection point or vents.

ae. Pantograph: A fuel servicing system consisting of multiple rigid sections of tubing interconnected by articulating and swivel couplings with fuel flow controlled by a deadman switch.

af. Ramp Grounds: Ground rods used on ramps or aprons for protection against stray electrical currents, electrical faults, lightning, and static electricity.

ag. Rapid Defueling: A means to rapidly offload fuel from a -135 series aircraft either by operating an outboard engine or external hydraulic test stand to power on-board refueling pumps.

ah. Refueling: The movement of fuel from an external source to an aircraft.

ai. Remote Control Fuel Switch: A portable pushbutton on/off explosion-proof switch attached to the hydrant outlet by an insulated, flexible control cable and used to start and stop fuel flow. This may also be a magnetic switch with a lanyard.

aj. Servicing Crew Member: A person in AFSCs 11XXX, 305X4, 2AXXX, 2W1XX or 2F0X1 who performs duties required by the specific servicing checklist under the supervision of the oxygen, refuel/defuel supervisor, or chief servicing supervisor.

ak. Shelters:

(1) Aircraft Alert/Zulu Shelter: A minimum insulated, garage-type structure intended to protect the aircraft from the elements. The structure is not intended as an aircraft maintenance facility but may contain all essential utilities.

(2) Hardened Aircraft Shelters (HAS): Refer to figure 5-1.

(a) There are four basic types of hardened aircraft shelters:

1 First Generation Shelters: These shelters have two manually operated, vertically hinged, prow-shaped, recessed, metal aircraft entry doors. Usable floor space is 48 feet by 75 feet.

2 Modified First Generation Shelters: These shelters have one electrically operated, side opening, roller supported, prow-shaped, externally mounted, metal aircraft entry door. Usable floor space is 48 feet by 100 feet.

3 Second Generation Shelters: These shelters have two electrically operated, side opening, roller supported, externally mounted, reinforced concrete panel aircraft entry doors. Usable floor space is 82 feet by 124 feet.

4 Third Generation Shelters: Same as second generation except usable floor space is 71 feet by 120 feet.

(b) Hardened Aircraft Shelters are used for two principal purposes:

1 Operational Shelter: Provides physical protection of aircraft, accommodates all through flight and flight preparation activities, all on-equipment aircraft maintenance requirements,

and some off-equipment aircraft maintenance requirements.

2 Maintenance Shelter: Provides physical protection of aircraft. Accommodates all levels of on and off equipment maintenance.

al. Supervisory Contractor Representative (SCR): The person responsible for the control of contractor personnel involved in concurrent servicing operations, fuel nozzle connection/disconnection, and operation of refueling control panel on commercial aircraft.

am. Support Equipment (SE): All equipment required on the ground to make a weapon system, command and control system, subsystem, or end item of equipment operational in its intended environment. Included is equipment needed to install, launch, guide, control, direct, inspect, test, adjust, calibrate, gauge, measure, assemble, disassemble, handle, transport, safeguard, store, activate, service, repair, overhaul, maintain, or operate the system, subsystem, end item, or component.

an. Switch Loading: The introduction of a low volatility fuel such as JP-8 into a tank containing a residue of a higher volatility fuel such as JP-4, and vice versa.

ao. Transferring of Fuel: The movement of fuel within the aircraft internal fuel system. This term also applies to bulk movement of fuel.

1-9. **REPORTING OF HAZARDS.**

1-10. Any potential hazard shall be reported to supervision. Examples of hazards that should be reported are:

a. Glowing or crackling fuel.

b. Visible areas or sparks from any source.

c. Electrical shocks to personnel.

d. Aircraft with defective grounding/bonding receptacles.

1-11. **RECOVERABLE PRODUCTS.**

1-12. Recoverable products resulting from ground handling and servicing of aircraft will be handled in accordance with federal, state, and local pollution control laws. Refer to AFI 23-502, Recoverable and Unusable Liquid Petroleum Products, and TO 42B-1-23, Management of Recoverable and Waste Liquid Petroleum Products. Fuel or oil spills will be reported to the base fire department and the civil engineering pollution control response team as required by local directives.

1-13. **SYSTEM SAFETY ENGINEERING ANALYSIS (SSEA).**

1-14. An SSEA is a detailed engineering review of an operation. It includes failure modes and effects analysis, criticality assessments, and operating and support hazard analysis as outlined in MIL-STD-882. These analyses consider the weapon system, the support equipment, and the personnel interfaces. An SSEA is used to establish the degree of risk involved in a new procedure. Any change to the approved hot refueling, concurrent servicing, or integrated combat turn around procedures listed in this technical order, or the addition of new procedures, require HQ AFMC/SES approval. Refer to AFI 91-202, Chapter 9, paragraph 9.7, or contact HQ AFMC/SES for an explanation of policies, responsibilities, authority, and administrative steps necessary to request an SSEA.

SECTION II

NATURE OF ELECTROSTATIC HAZARDS AND STRAY CURRENTS

2-1. GENERAL.

2-2. Fire or explosion hazards are always present where fuels are handled. The grounding or bonding of all conductive parts of the system are an effective means of controlling hazards created by electrostatic energy.

2-3. ELECTROSTATIC CHARGES.

2-4. Static electricity is frequently generated when two materials are brought into contact and then separated. Removing items of clothing, dust blowing across a surface, a liquid flowing through a pipe, and moving vehicles are common means of producing a static charge. Static electricity has been the ignition source for many petroleum fires. Protection against static charge buildup is obtained by dissipating static charges through proper connections to the ground or equalizing static charges through effective bonding.

2-5. STRAY CURRENTS.

2-6. Electrical currents flowing through paths other than their intended circuits, or any extraneous current in the earth are stray currents. Since Air Force fixed refueling systems are in contact with the earth, stray currents sometimes take paths through the conducting parts of the system. Grounding or bonding do not eliminate stray currents. Grounding provides a continuous electrical path to ground, whereas bonding equalizes the electrical potential between two conductive objects.

2-7. COMBUSTION.

2-8. Combustion requires fuel vapors, air (oxygen), and an ignition source. Flammable vapors exist over the surface of JP-4 at -10 degrees F and above, and aviation gasoline at -50 degrees F and above. Ignition of these vapors can be caused either by a spark or flame. When the proper ratio of fuel vapor and air is present, ignition will result in fire or explosion. Energy levels associated with electrostatic discharges may be sufficient to ignite fuel vapors.

2-9. ELECTROSTATIC CHARGING OF PERSONNEL.

2-10. The normal activity of personnel involved in refueling operations can generate static electricity charges on their clothing. Humidity greatly affects the static electricity characteristics of clothing materials. The lower the humidity, the higher the electrostatic hazard. Under low humidity conditions, almost all Air Force issued garments can produce a static charge of sufficient potential to cause a discharge. The wearing of multiple garment layers in itself does not cause an excessive static charge to develop. However, never remove any garment while in the refueling area. Antistatic finishes are not permanent and are gradually removed by laundering or dry cleaning. In addition, antistatic finishes are not as effective in low humidity conditions or at low temperatures. Moisture increases the electrical conductivity of clothing and this is why high humidity conditions minimize static build-up problems. Body perspiration has the same effect by adding moisture to undergarments and outer clothing. Insulated foot wear limits the dissipation of static charges to the ground. Both rubber soles and composition soles are relatively poor conductors but most have sufficiently low resistances to dissipate static charge. The same is true for gloves. In most cases, personnel can dissipate static charges through gloves or soles, but, as an added precaution, personnel should touch a grounding/bonding point with their bare hand. Personnel wearing Chemical Warfare Defense Ensembles (CWDEs) do not need to remove any clothing to dissipate static buildup. They can adequately ground or bond themselves directly through the CWDE boot or glove. Clothing having a surface resistivity of less than 10^{12} ohms per square or an inside-to-outside resistance of less than 10^{10} ohms will dissipate static charges through normal grounding procedures or equalize static charges through normal bonding procedures. Many aircraft have avionics line replaceable units (LRUs) having electronic components that are sensitive to static discharges. When removing or replacing these units, personnel should electrostatically equalize themselves with the aircraft prior to touching the LRUs. The preferred contact/equalization point is just inside the applicable avionics bay. When handling or carrying the LRUs, avoid touching any connector pins or jacks because they might be directly connected to sensitive electronic components. Any connector or jack caps/covers should be installed whenever the LRUs are disconnected from the aircraft. Once the LRUs are in the avionics shop for repairs, standard safeguards (e.g., TO 00-25-235) will suffice to prevent electrostatic damage.

2-11. TANK FILLING.

2-12. During the tank filling process, the electrical potential of the liquid fuel surface may reach thousands of volts. A spark may discharge from the surface of the liquid to the internal surfaces of the tank or any other object in the tank such as piping, fittings, or foreign material. If the fuel vapor-air mixture above the liquid surface is in the explosive range, such a spark will provide ignition with disastrous results. Objects in a fuel tank will collect a charge from the fuels and become similar to an electrical condenser (capacitor) plate. The potential required for a discharge from these floating objects to the tank is less than that required to cause a discharge from the liquid surface to the tank. Therefore, the hazard is greatly increased by the presence of such objects. The Air Force now incorporates a conductivity additive to decrease the relaxation time of electrostatic charges in order to preclude these problems. Also, the use of a higher flash point fuel such as JP-8 or JP-5 in lieu of JP-4, when permitted by the applicable aircraft technical orders, reduces the vapor ignition hazard. Research has suggested that if fuel flow is kept below the following maximum rates, hazardous levels of static electricity charges will not occur:

Nozzle/Hose/ Pipe Diameter	Gallons/Minute
0.75 inches	32
1.50 inches	125
2.00 inches	191
3.00 inches	260
4.00 inches	385
5.00 inches	542
6.00 inches	693

These limits do not apply for JP fuels having anti-static additives with at least 50 conductivity units (CU).

2-13. LIGHTNING.

2-14. Even if an aircraft were statically grounded, a severe hazard to servicing personnel could exist if lightning strikes the aircraft or within several hundred feet of the aircraft. Servicing personnel should be evacuated from the area when there is danger of a direct or close proximity lightning strike. Personnel inside an aircraft will be in no danger as long as all aircraft doors, hatches, and canopies are closed. Potentials in the range of several million volts exist between clouds and earth. High points such as vertical stabilizers and antenna masts are most susceptible to strikes. These strikes are of short duration (approximately 1/100 second duration per strike) and even though high energy levels exist, the ramp grounding system will generally conduct the energy safely to earth. An electrical storm can be dangerous even if several miles from the servicing area.

2-15. OTHER SOURCES OF STATIC ELECTRICITY.

2-16. Operating aircraft engines, rotor blades, and propeller blades, can generate high static electricity voltages. These static sources are especially hazardous because the static voltages may be generated continuously as long as the engines/blades continue to operate.

SECTION III

GROUNDING AND BONDING

3-1. **GENERAL.**

3-2. Grounding is the process of connecting one or more metallic objects and ground conductors to ground electrodes. Bonding is the process of connecting two or more metallic objects together by means of a conductor. Bonding is done to equalize electrostatic potential between two or more conductive objects.

3-3. **POLICY.**

3-4. Grounding is not required for parked aircraft or aircraft fuel servicing operations. Aircraft will be bonded to fuel servicing equipment at all times during fuel servicing operations. Hydrant fuel servicing vehicles and hosecarts will also be bonded to the hydrant system in addition to bonding to the aircraft. (This hydrant servicing vehicle or hosecart bonding requirement applies only when the aircraft is not grounded.)

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

NOTE

- If the bonding wire becomes disconnected, reconnect it immediately. The sequence makes no difference.
- Bonding is not required for all-metal pantograph, as long as there is a continuous metal structure from the fuel servicing equipment to the aircraft.

a. Grounding of aircraft or supporting servicing equipment during either fuel servicing, liquid oxygen (LOX) servicing, gaseous oxygen (GOX) servicing, liquid nitrogen (LIN) servicing, or gaseous nitrogen (N_2) servicing is not required. Recent electrostatic studies have demonstrated that grounding aircraft or supporting servicing equipment for these situations is unnecessary. Grounding is not required for aircraft except when aircraft are:

(1) Undergoing munitions loading/unloading operations.

(2) Undergoing electrostatic painting, bead blasting or fuel system repair.

(3) Connected to a hangar electrical power source. (This requirement does not apply to portable ground power units, including MD/4MO mobile electric power units, inside hangars.) Some locations with low humidity may want to ground an aircraft one time after landing to dissipate any static charges generated on the aircraft while flying through dust or precipitation. This will be accomplished by momentarily connecting a cable from an earth ground to any unpainted metallic aircraft surface.

b. Overwing (open port) fuel servicing operations require a bonding wire between the fuel source and the aircraft, and a separate bonding wire for each open port fuel nozzle. The first bonding wire equalizes static charges that accumulate while fuel is flowing during fuel servicing operations. The second bonding wire prevents a charged fuel nozzle from creating a spark at the open fuel port when the fuel nozzle first touches the aircraft.

c. Drop, external, ferry, benson, and weapons bay fuel tanks do not need to be grounded when stored, parked, or during other periods when in-tank work is not being accomplished.

d. The connecting of more than one grounding/bonding cable by any means (clamp-to-clamp, clamp-to-handle, etc.) using any method (stacking, piggy-backing, nose-to-nose, etc.) is not authorized, except as specified in (1) or (2) below.

(1) A conversion jumper may be constructed to provide bonding capability for over-the-wing fuel servicing nozzles when aircraft to be serviced are not equipped with electrical jack assembly receptacles. Conversion jumpers will be made from only the parts listed below and assembled as follows: connect an electrical ground wire rope (cable), NSN 4010-00-575-6234 or NSN 4010-00-286-2681, to terminals of a female extension jack, NSN 5935-00-432-9340 ; cut electrical ground wire rope (cable) to length required; place a red warning streamer, NSN 8345-00-673-9992, on cable and then install an electrical ground clip, NSN 5999-00-134-5844 or NSN 5999-00-204-8350 on free end of cable. Perform a continuity check to make sure conversion jumper is electrically interconnected throughout assembly.

(2) A multiple receptacle junction box may be constructed to reduce the number of grounding/bonding cables around a work site. The multiple receptacle junction box must be built from a high quality conductive material. The receptacles installed in the junction box must be female extension jacks, NSN 5935-00-432-9340 . All multiple receptacle junction boxes will be given a continuity test at the time of fabrication and at any time afterwards when a lack of continuity is suspected due to damage or corrosion. Resistance between the body or frame of the junction box and the installed female extension jacks shall not exceed 10 ohms.

3-5. **GROUNDING.**

3-6. The proper connection sequence to ground an aircraft using a clamp-plug unit as described in paragraph 3-10d is to first attach a grounding clamp to the earth grounding point, and then either insert the plug of the other end of the clamp-plug unit into an aircraft receptacle jack assembly or

attach the clamp of the other end of the clamp-plug unit to an unpainted metal portion of the aircraft.

3-7. **AIRCRAFT INSTALLED ELECTRICAL RECEPTACLES FOR GROUNDING AND BONDING.**

3-8. Aircraft system managers, in coordination with using MAJCOMS, shall insure applicable aircraft technical orders include a requirement to inspect aircraft electrical receptacles during or at appropriate maintenance phase schedule and after receptacle maintenance. The inspection methods and frequency will also be included in the specific aircraft technical orders. In the absence of any inspection methods listed in aircraft technical orders, receptacles will be inspected and tested in the following manner:

a. Visually inspect for loosely mounted receptacles and evidence of corrosion on washers, lugs, nuts, and the aircraft skin. There shall be no free axial movement of the contact tip in the plug due to clearance between the contact (spring) tip and plug. Free axial movement indicates the contact spring is not maintaining a proper connection with the plug.

b. Inspect and test for electrical resistance as follows:

(1) Electrical resistance between receptacles and clean aircraft skin shall be one ohm or less on an 815AFA bridge or equivalent.

(2) A stainless steel plug, part No. MS3493, NSN 5935-00-572-5174, will be inserted into the receptacle jack assembly. Check to ensure it is firmly seated. Electrical resistance measured between the plug and cleaned aircraft skin must be one ohm or less, but not zero. The aircraft technical order is applicable if it specifies a value less than one ohm. A clamp, part No. M83413/7-1, may be substituted for the steel plug on aircraft not equipped with the jack assembly, part No. MS90298, when attached to designated grounding lugs on an unpainted part of the aircraft landing gear.

(3) A firm pull will be required to withdraw the plug from the receptacle. Approximate pull will measure 8 - 14 pounds on a spring scale, NSN 6635-00-578-5286, or equivalent. A pull of less than eight pounds indicates a weak or damaged receptacle and will be replaced. A pull of over 14 pounds indicates a possible corroded receptacle which might warrant replacement.

NOTE

A locally fabricated tool assembly may be used to assist in resistance test on aircraft installed grounding/bonding receptacles. The assembly consists of a grounding/bonding plug, NSN 5935-00-572-5174, grounding/bonding cable, NSN 4010-00-286-2681, six inches in length, and a wire rope swaging sleeve, NSN 4030-00-132-9163. Assemble as follows: install one end of six-inch grounding/bonding cable into grounding/bonding plug jam nut. Using opposite end of six-inch grounding/bonding cable, form a loop ending near grounding/bonding plug jam nut. Secure loop by placing both ends of grounding/bonding cable in a wire rope swaging sleeve and crimp. The loop can now be used as connection point for spring scale to conduct pull resistance test.

(4) Defective jack assemblies will be replaced with part No. MS90298 receptacles. Latest assembly has a one-half inch curved base on contact. Outdated aircraft jack assemblies which are to be replaced are one-fourth inch across contact base with two solder lugs and a right angle bend near the end of contact.

c. After receptacles meet the criteria outlined in step b, continuity check will be accomplished to assure all are electrically interconnected through the aircraft airframe and/or skin. For this test, use a portable static grounding/bonding cable. Resistance of the portable grounding cable shall be balanced out prior to use. In all cases, the resistance between receptacles should be one ohm or less.

3-9. **GROUNDING / BONDING HARDWARE.**

3-10. The following hardware items will be used and inspected as indicated:

a. Clamp (part No. M83413/7-1 only). Replace clamp if jaws are deformed, spring is weak, or other defect is evident that would prevent a good connection.

b. Plug (part No. MS3493 only). Inspect the electrical ground/bond plug for corrosion, weakness, or loose nut and replace if heavily dented or deformed, particularly around the portion which connects with the aircraft grounding/bonding receptacle.

c. Cable (3/32 inch, NSN 4010-00-286-2681 or NSN 4010-00-575-6234 only). Replace cable if more than one-third of the cable wires are broken. If electrical continuity is suspect, the cable will be checked and repaired if found to be bad.

NOTE

Deteriorated plastic coating does not affect the electrical capability of the cable.

d. Clamp-Plug Unit. The primary unit used by Air Force activities consists of a clamp and plug attached to opposite ends of a sufficient length of 3/32 inch cable. The unused handle of the clamp can be equipped with a sufficient length of 3/32 inch cable terminating into a plug. A warning streamer "REMOVE BEFORE FLIGHT" will be attached to the plug end of the cable. Other clamp-plug unit configurations may be used as mission needs dictate as long as specified hardware is used to construct them. The cable retainer (cap) of the two-piece plug and cap assembly design may be spot welded to prevent loosening of the cable and possible loss of continuity.

e. Locally-fabricated clamp-plug units will be checked with a multimeter for continuity prior to being placed into service. The continuity check test points should be from the inside of clamp jaws to end of plug. A continuity check should be performed any time a lack of continuity is suspect due to corrosion buildup or damage. A nominal 100-foot length of 3/32 inch diameter stainless steel cable will have a maximum allowable resistance of ten ohms.

f. When grounding is required for bare base operation, grounding rod, NSN 5975-00-240-3859, will be used.

g. Static Grounding/Bonding Reel Inspection Criteria. All installed static discharge reels shall be given a continuity test at the time of initial installation and at any time a lack of continuity is suspected due to damage or corrosion. The test will be accomplished by extending the entire length of the cable and measuring the continuity between the plug or inside the clamp jaws to the equipment frame on which the reel is mounted. Resistance between these two points shall not exceed 10 ohms. Prior to each use, the grounding reel shall be visually inspected for security of mounting on a rigid base and evidence of any corrosion or damage.

3-11. PERSONNEL GROUNDING/BONDING.

3-12. Personnel will use grounding or bonding techniques to dissipate or equalize static charges that have accumulated during ground servicing operations. During an aircraft fuel servicing operation, a static spark in the wrong place could ignite a fuel vapor concentration. Fortunately, normal fuel servicing operations have ignitable flammable vapor concentrations only near aircraft fuel vent outlets. These vapor concentrations generally dissipate rapidly to levels that are too lean to be ignited. An aircraft fuel system failure, however, could result in fuel spilling from vent outlets or from other locations. This increases possibility of an ignition from a static spark. Therefore, prior to any fuel servicing or munitions loading/unloading operation, personnel involved in the operation will ground or bond themselves to a suitable grounding/bonding point or to a bare (unpainted) portion of the aircraft. If a spark occurs during the initial grounding or bonding procedure, then atmosphere conditions are ideal for additional static charge accumulations; therefore, under this condition, personnel will ground or bond themselves periodically. If no spark occurs during the initial grounding or bonding procedure (or other symptoms do not occur), then additional grounding or bonding is not necessary. All personnel will avoid grounding or bonding themselves within three feet of aircraft fuel vent outlets. In addition, personnel conducting aircraft fuel vent checks will ground or bond themselves above waist level and at least three feet from fuel vent outlet prior to checking vent. Weapons loading personnel will ground or bond themselves when entering fuel servicing safety zone and before handling electrically-primed munitions. Always avoid touching the primers of electrically-primed munitions (i.e., impulse cartridges and 20 MM ammunition). Personnel entering a fuel servicing or weapons loading area should also ground or bond themselves to the closest piece of grounded or bonded aircraft or equipment.

3-13. Chemical Warfare Defense Ensemble (CWDE) resistance tests have shown that static charges can be effectively dissipated through CWDE boots or gloves (preferred) which have resistances of approximately 10,000 ohms. Personnel can ground or bond themselves directly through the CWDE glove; therefore, removal of any of the CWDE for grounding or bonding purposes is not required.

3-14. When servicing aircraft with low flashpoint fuels (i.e., JP-4, AVGAS, and Jet B), personnel armor (flak vest) should not be worn while performing fuel servicing operations except in actual combat. In all cases (i.e., servicing with any fuel), the following precautions apply. Flak vest resistance tests have shown that static charges cannot be effectively dissipated by normal grounding or bonding procedures. The flak vest is an electrical insulator with an extremely high resistance. The flak vest will generate and accumulate a static charge during a person's normal movement. This accumulated charge will then be equalized on the person's body. When normal grounding or bonding procedures are used, the charge on the person's body will be dissipated or equalized, but the charge on the flak vest will not. An individual wearing a flak vest will always ground or bond himself when approaching an aircraft and prior to beginning work. If no spark occurs during bonding or grounding, then conditions are not present to accumulate a static charge with sufficient energy to be hazardous; therefore, normal work may begin. If a spark does occur during bonding or grounding, the flak vest wearer will ground or bond frequently during all work phases.

SECTION IV

GENERAL PROCEDURES

4-1. **HOUSEKEEPING.**

4-2. A clean work area makes a safer, more efficient operation. High standards of cleanliness shall be maintained in the hazardous environment of aircraft ground servicing. Aircraft parking areas, servicing aprons, fuel servicing vehicles/ equipment, and support equipment (SE) compartments and surfaces shall be kept free of debris and accumulation of oil, hydraulic fluids, grease, or fuel. Personnel shall not be subjected to increased risk to catch servicing fluids. If a spill occurs, it shall be controlled in accordance with local regulations once the aircraft and surrounding area are made safe.

4-3. **AIRCRAFT FLUIDS AND FUELS.**

4-4. The servicing of aircraft jet fuels, hydraulic fluids, and lubricants, presents a potential fire or explosion hazard. Flammable mixtures can be formed by the vapors from JP-4 fuel, or from a spray or mist from a pressurized leak. Flammable vapors are present when the temperature of JP-4 fuel is greater than –10°F. The vapor concentration depends on both the fuel temperature and the ambient temperature. As the temperature increases, the vapor concentration increases. The temperature at which the concentration of vapors is sufficient to form a flammable mixture without propagating is known as the flash point temperature (–10°F for JP-4). The term lower flammable or explosive limit (LFL or LEL) is the minimum concentration of vapor-to-air where flame will occur with an ignition source and continue to propagate. The upper flammable or explosive limit (UFL or UEL) is the maximum vapor-to-air concentration above which propagation of flame will not occur. These flammability limits (1.3 percent to 7.0 percent by volume) are established under controlled laboratory conditions and are not directly applicable to servicing of aircraft. The fuel vapors, being heavier than air, tend to cling to the ground. At some distance above the fuel surface, the mixture of fuel vapors and air is flammable. Therefore, it is necessary to treat any JP-4 fuel spill as being flammable. For comparison, JP-8 fuel has a much higher flash point and is relatively safer to use. The flash point of JP-8 is +100°F, if the fuel temperature is less, JP-8 vapors will not be present above the surface of the fuel.

4-5. Pressurized refueling operations present a potential hazard for pressure leaks in equipment, pipes, and hoses. These failures may cause a fine spray or mist to be present. If there is an ignition source, there could be a fire regardless of the fuel's flash point temperature. Constant vigilance is needed to eliminate potential ignition sources from the servicing operations. JP-4 fuel vapors, for example, can be ignited by a very small energy spark. The energy associated with metal tools being dropped on concrete, sparks generated when grounding or bonding equipment, static electricity generated by personnel, the arcing of electrical/ mechanical equipment, and sparks/hot particles from an engine exhaust will ignite JP-4 fuel vapors. The less volatile petroleum products, such as JP-5 or JP-8 fuels, hydraulic fluids, or lubricants will not normally ignite unless the fluid is in direct contact with the ignition source. Open flames, electrical arcing, and hot surfaces are all potential ignition sources.

4-6. During refueling operations, the most common ignition sources present are hot surfaces above 750°F, such as hot brakes, bleed air ducts, hot engine, and APU surfaces. In many servicing operations, the hot surface may be present on the support equipment. Once a fire starts, the spread is quite rapid. The flame temperature is approximately 2000°F and is well in excess of the melting temperature of aluminum alloys (1000°F). Therefore, it is necessary to have fire fighting equipment immediately available as specified in table 4-1.

4-7. **SERVICING SUPERVISOR.**

4-8. Fuel and water servicing will be conducted under the direct control of the servicing supervisor. This supervisor will be completely familiar with this technical order and the applicable aircraft -2 technical order(s). In addition, this supervisor must demonstrate a thorough knowledge of all equipment and systems involved in the servicing operations and be certified in accordance with Command directives. This supervisor will insure that all applicable safety precautions and technical order requirements are taken and/or observed prior to, during, and after all servicing operations. This supervisor shall be responsible for assigning, monitoring, directing, and controlling the duties of personnel under his or her supervision as follows:

a. Check the markings on the refueling equipment to verify that the correct grade of fuel is being supplied to the aircraft.

b. Control the movement and correct positioning of aircraft and servicing equipment to, from, and within the servicing areas.

c. Verify the positioning and type of fire extinguishers.

d. Evacuate non-essential personnel and equipment.

e. Shutdown powered SE not essential to servicing and, if necessary, move to a point where it will not obstruct operations.

f. Verify that the correct grounding/bonding sequence is accomplished.

g. Establish and maintain either visual or voice contact with the control panel operator and/or servicing equipment operator(s). If the aircraft is equipped with intercom communications for ground operations, it will be used to maintain, voice contact with fuel panel operator(s) at all times during servicing.

NOTE

For commercially contracted cargo-only aircraft where the fuel control panel/ fuel system control mechanism is located on the outside of the aircraft (L-100, L-188, DC-9, and B-727), use of the aircraft intercom system by servicing ground crews is not required. If any personnel (flight or ground crew members) are to remain on board the aircraft during fuel servicing operations, then voice contact must be established and maintained between the personnel remaining on board the aircraft and the fuel control panel operator(s) at all times during the fuel servicing operation.

h. For single point servicing, the fuel servicing supervisor will insure the SPR nozzle is properly connected to the aircraft fueling receptacle.

NOTE

Connect the SPR nozzle to the aircraft. With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking. Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. On aircraft with Refueling Teams (C-5, C-130, C-141, B-52, and KC-135), the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

i. During over the wing/open port fuel servicing, insure the bonding wire is installed prior to opening the filler cap and that the fuel nozzle operator does not block or jam the nozzle in the open position or leave it unattended.

j. Ensure communication is available through Job Control or the Command Post to Fire Protection Agencies.

k. Ensure personnel are thoroughly familiar with and qualified to perform safe servicing operations.

l. Implement immediate shut down procedures if an abnormal condition (i.e., power loss or fuel gage malfunction) occurs during fuel servicing.

4-9. **FUEL SERVICING SAFETY ZONE (FSSZ).**

4-10. This is the area within 50 feet of a pressurized fuel carrying servicing component; i.e., servicing hose, fuel nozzle, single point receptacle (SPR), hydrant hose cart, ramp hydrant connection point, etc., and 25 feet around aircraft fuel vent outlets. (Aircraft interiors are not considered part of the FSSZ unless canopies, ramps, or doors are open exposing part of the aircraft interior to a spilled or sprayed fuel hazard.) The fuel servicing safety zone is established and maintained during pressurization and movement of fuel. See figure 4-1 for an example of the B-52 pit refueling safety zone and figure 4-2 for an example of the F-4 truck refueling safety zone. During fuel movement, active ignition sources shall be removed and kept out of the fuel servicing safety zone. Some examples of active ignition sources are open flames, sparks from internal combustion engines, and electrical arcing.

NOTE

The FSSZ applies to all servicing operations except where specific distances are prescribed for individual servicing operations, i.e., hot refueling.

4-11. **THE AIRCRAFT BEING SERVICED.**

4-12. Non-essential aircraft electrical systems, including radar, shall not be activated on the aircraft during servicing operations unless absolutely required for servicing. The power off portion of aircrew walkaround inspections may be performed when essential to meet established operational turnaround requirements.

4-13. **ADJACENT AIRCRAFT.**

4-14. Such aircraft, parked as prescribed in AFH 32-1084 and which intrude into the fuel servicing safety zone shall not be:

a. Involved in engine starts or engine trim operations.

b. Radiating electromagnetic energy.

c. Using NDI or welding equipment.

d. Involved in any maintenance requiring:

(1) Energizing or de-energizing external electrical circuits.

(2) Disconnecting combustible fluid carrying lines, except those equipped with non-spill, quick disconnects.

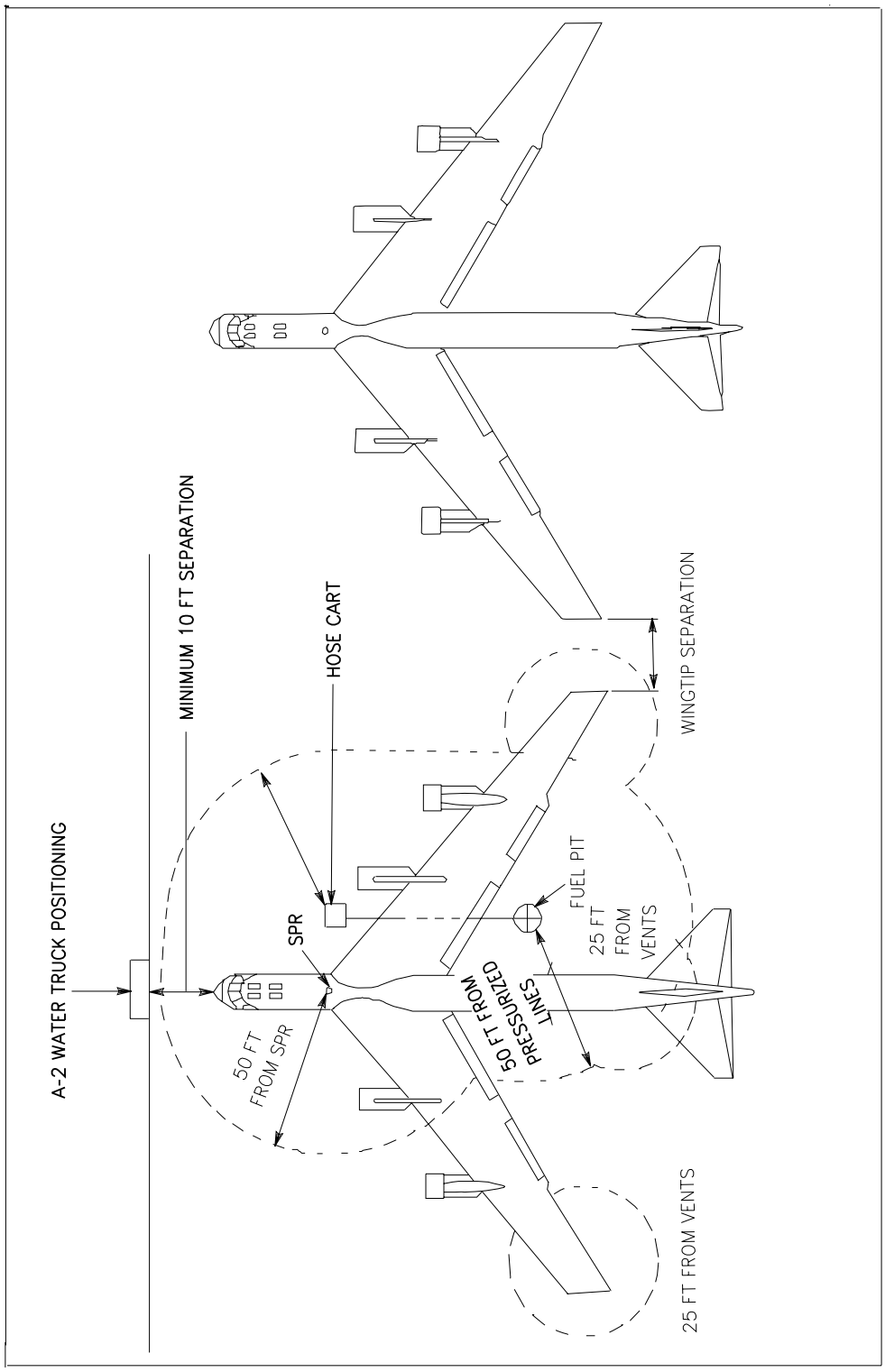

Figure 4-1. B-52 Pit Refueling Safety Zone Example

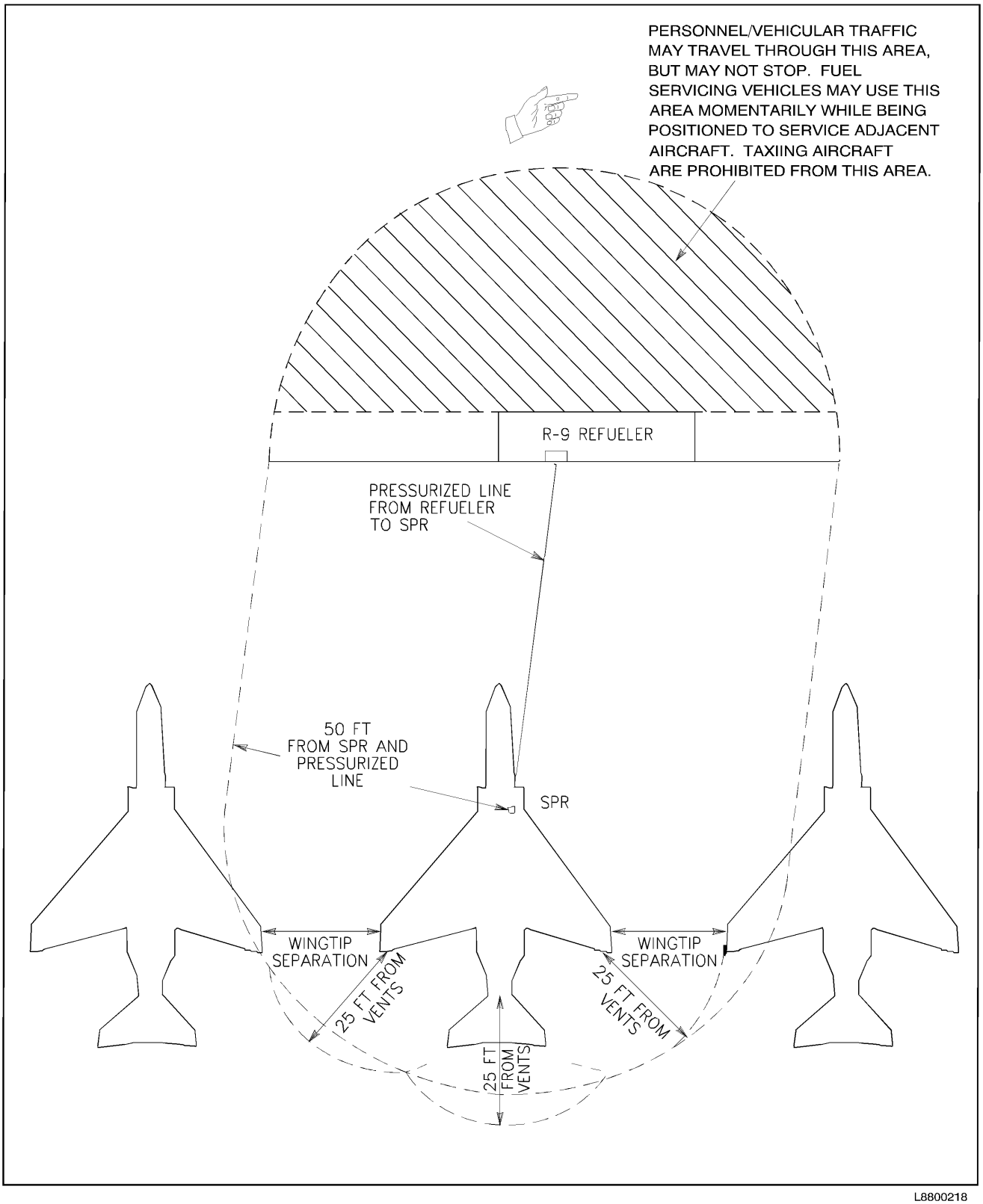

Figure 4-2. F-4 Truck Refueling Safety Zone Example

e. Moved under its own power.

NOTE

However, normal maintenance, including pre/postflight inspections involving internal aircraft electrical power, may be performed on adjacent aircraft providing there are no spilled flammable liquids.

4-15. SERVICING CONSTRAINTS.

4-16. The following constraints apply during servicing operations:

a. During servicing, only those personnel actually required for the operation shall remain in the fuel servicing safety zone. Aircrews on commercial contract cargo-only aircraft, including LOGAIR or QUICKTRANS, may remain on board the aircraft during servicing operations. Personnel receiving training on specific tasks required to complete the fuel servicing operation are allowed in the FSSZ if they are under the direct control and supervision of the fuel servicing supervisor. Quality inspectors may enter the FSSZ to perform quality assurance functions. Personnel performing authorized functions on adjacent aircraft which intrude into the FSSZ may remain on duty with the adjacent aircraft. The servicing supervisor will coordinate with all affected personnel so that these restrictions are observed. There shall be no smoking within 50 feet of any aircraft or servicing operation. Servicing operations shall not begin if any indication of "hot brake" is noted.

b. Aircraft radar and high frequency (HF) radios shall not be operated in the transmit mode within 300 feet of servicing operations, unless otherwise specified in the applicable aircraft and equipment repair technical orders, or when TO 31Z-10-4 procedures are used to insure a safe distance. Satellite communications (SATCOM) radios may be operated in the transmit mode if the antenna beam is pointed at least ten degrees above the horizon.

c. Do not start servicing operations (any movement of fuel, water, water/alcohol, environmental fluid, oil, hydraulic fluid, oxygen, nitrogen, or hydrazine) whenever one of the following conditions exists. If servicing operations are already in progress, terminate as soon as practical:

(1) When a lightning advisory has been issued indicating an electrical storm is within five miles of the servicing area.

(2) Winds reach velocities hazardous to the aircraft or servicing operations. Specific high wind restrictions will be developed by base-level personnel for each base supporting a flying mission.

(3) Fire in the vicinity is generating hot ashes.

(4) If an aircraft crash/fire occurs at the same airfield, servicing operations already underway will be stopped and fuel servicing equipment will be disconnected. No new servicing operations will be started until the crash/fire is declared under control by the base Fire Chief, his designated representative, or the on-scene commander, and an aircraft rescue and fire fighting vehicle is available to support servicing operations.

(5) In the event of an Inflight Emergency (IFE) or crash warning, servicing operations already underway may be completed. No new servicing operations may be started without the concurrence of the base Fire Chief, his designated representative, or the on-scene commander, or until the IFE or crash warning has been cancelled. As a condition of continuance during IFEs, either an operational fixed, skid mounted, or portable AFFF fire suppression system discharging through oscillating nozzles or at least one fully manned aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) must be positioned at a location where response can be made to the runway within one minute and the aircraft servicing area within three minutes.

WARNING

In freezing weather, touching a metal surface with bare skin can cause the skin to stick to the cold surface, resulting in a painful injury. One way to avoid this is to touch the aircraft grounding/bonding connector with a warm metal object, such as a coin held in the bare hand.

d. Personnel in the FSSZ shall not wear footwear with exposed spark-producing nails or metal plates on the walking surfaces. Any type of clothing may be worn as outer garments when fuel servicing aircraft with high flashpoint fuels (JP-5, JP-8, JP-10, JET A, JET A-1, or diesel). However, when fuel servicing aircraft with low flashpoint fuels (JP-4, JET B, AVGAS, or MOGAS), clothing containing more than 65% of any combination or mixture of nylon, rayon, wool or polyester shall not be worn as outer garments. Do not put on or remove outer garments in the fuel servicing safety zone. Matches or lighters will not be handled or removed from pockets during servicing operations. If flight crew members wearing Nomex and/or other authorized flight clothing are required to assist in aircraft fuel servicing operations, they will first assure that they are at the same potential as the aircraft. This is done by bare hand

contact with the aircraft grounding/bonding connector, an unpainted aircraft surface, or a static ground before removing the fuel filler cap or while inserting the bonding jack on the fuel nozzle.

e. Laptop computers, cellular telephones and radios can be operated within the FSSZ. However, no battery changes for the laptop computers, cellular telephones or radios are allowed within the FSSZ and only intrinsically safe radios can be operated within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling).

f. If hot brakes are suspected, an aircraft hot brake check will be performed prior to fuel servicing. Fuel servicing shall not start until the brake temperature is below 750 degrees F, except for the A-10 and F-15 aircraft. The A-10 and F-15 aircraft are excepted because of the location, direction, and distance of the fuel vent outlets from the aircraft landing gear brake assemblies.

g. If glowing or crackling fuel is noted when servicing aircraft, immediately cease all servicing operations. Report the incident to the servicing supervisor and to the fire department. After the incident is investigated, recheck grounding connections, and resume flow at a slower rate and pressure.

h. Deleted.

i. Operating external power units will be parked outside the fuel servicing safety zone which is at least 50 feet from the pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vent outlets. The operating units will be positioned upwind from the fuel servicing operation when possible.

CAUTION

The aircraft settles as fuel is taken on board. Ensure adequate clearance exists between the aircraft and maintenance stands or equipment positioned under any portion of the aircraft.

j. Bond conductive aircraft maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations. Other maintenance or work stands, not used for fuel servicing, do not require either bonding or grounding.

NOTE

Fiberglass is a non conductive material (insulator) that does not dissipate or transfer electrostatic charges when either grounded or bonded to conductive objects. Therefore, the grounding or bonding of fiberglass ladders or work stands is not required.

k. On aircraft equipped with individual fuel tank quantity gauges, monitor each gauge during refueling operation. If any tank appears to fill abnormally slow or not at all, then stop all refueling immediately and investigate to determine what is causing the problem. The cause could be a blocked vent line or failed refuel shutoff valve.

4-17. **SERVICING VEHICLES AND SUPPORT EQUIPMENT (SE).**

4-18. The following applies to all servicing vehicles and support equipment:

a. Deleted.

b. For support equipment operating on the flight line, but not in the fuel servicing safety zone, normal equipment maintenance and inspection requirements apply.

c. Aircraft servicing safety constraints. Do not service aircraft if any of the following safety discrepancies exist:

(1) Defective servicing hose.

(2) Fuel leaks.

(3) Defective or bare electricalwiring.

(4) Defective throttle or PTO Interlock System.

(5) Defective hand or foot brakes.

(6) Defective exhaust system.

(7) Aircraft or support equipment engine(s) is (are) overheated.

(8) Defective or inoperative emergency shutoff switch.

(9) Defective shift linkage or gear shift indicator.

(10) Defective tank vent valves.

(11) Vehicle air pressure below 90 psi.

(12) Vehicle or support equipment engine backfires.

(13) Fuel filter pressure exceeds 15 psi.

(14) Defective deadman control valve.

(15) Defective nozzle.

4-19. **FIRE PROTECTION.**

4-20. Fire protection is essential during aircraft servicing operations, with the degree of fire protection based on the hazard involved in the operation being conducted. Personnel involved in servicing operations shall be trained in the operation of fire extinguishers and installed fire suppression equipment systems. In the event of a fire or fuel leak, on-site personnel are the first line of defense in protecting Air Force assets involved when fire department personnel are not located at the incident scene. On-site personnel are expected to immediately notify the fire department and use available fire extinguishers (or other equipment) until the fire department arrives on scene.

a. Fire extinguishers. The 150-pound, Halon 1211 fire extinguisher is the primary flight line fire extinguisher. Fire extinguisher requirements for specific situations are contained in applicable paragraphs of this technical order and are summarized in table 4-1.

b. Installed Fire Suppression Systems and Vehicle Standby. Certain aircraft servicing operations present increased hazards and require a greater degree of fire protection. Hot refueling operations require modular skid mounted or installed fire suppression equipment employing aqueous film forming foam (AFFF). When such systems have not been installed, fire protection is provided by standby fire fighting vehicles and crews. Refer to applicable paragraphs of this technical order and to table 4-1 for a summary of installed fire suppression system requirements and vehicle standby requirements.

c. Fire Department Standby Requirements. Table 4-1 lists various standby requirements for aircraft rescue and fire fighting vehicles. Due to a limited amount of equipment, on occasions the fire chief is required to direct standby vehicles to existing emergencies. An example is when the fire department responds to an inflight emergency (IFE). During IFEs, aircraft rescue and fire fighting vehicles are pre-positioned along the runway when an emergency landing is anticipated. The following fire protection policy applies during emergency situations.

(1) Operations which may continue. Integrated combat turnarounds (ICT) and hot refuelings (singular or multiple). These operations may continue fuel servicing until the present ICT or hot refueling is completed. No fuel servicing portion of a new ICT or hot refueling generation may begin unless authorized by the wing commander (or senior local operational commander) until the aircraft rescue and fire fighting vehicle has returned to the site. As a condition of continuance, there must be an immediate means of recalling the fire department to the standby location in case of an on-site emergency. In addition, two, 150-pound Halon 1211 extinguishers must be in position with one on each side of the aircraft. Servicing personnel shall be trained in the use of these extinguishers. Maintenance, fuel servicing, and aircrew personnel must exercise extra vigilance during this time period. When the fire chief releases the aircraft rescue and fire fighting vehicles from the emergency scene, they will reservice as necessary and return immediately to the standby location.

(2) Operations which must cease. Hot ICT(s), concurrent fuel servicing of aircraft with passengers onboard, fuel servicing of medical evacuation flights with passengers/patients onboard, defueling when an aircraft has a fuel leak, is damaged from fire or impact, defueling into open containers or drums, or defueling where safe distance criteria cannot be met or static grounding points are not available. These operations shall cease immediately. Fuel flow will be stopped and pressure relieved from the fueling system until the aircraft rescue and fire fighting vehicle has returned to the site.

Table 4-1. Fire Protection Equipment Requirements

Type of Operation	Fire Protection Requirements
WARNING Do not use Halon, carbon dioxide, or water (Type A, B or C Rated) fire extinguishers on or near fires involving munitions, pyrotechnics, or magnesium incendiaries (flares). The extinguishers listed in this Table should only be used for initial knockdown of fires on aircraft and equipment before the involvement of munitions, pyrotechnics, or magnesium incendiaries or to protect adjacent equipment and facilities. Always ensure you have the proper fire extinguisher for the class of fire hazard encountered. **CAUTION** Do not lay down the 150-pound Halon 1211 wheeled fire extinguisher. The flight line extinguisher must be utilized from the upright position. The laying down of the flight line extinguishers to prevent tipping or damage from engine exhaust subjects the extinguisher to fail to provide sufficient agent to suppress a file. If flight line personnel are concerned regarding this situation, they should relocate the extinguisher outside of the exhaust zone. NOTE All references to the Halon 1211 extinguisher are for the 150-pound wheeled extinguisher.	
1. POL servicing vehicle parking area.	The Fire Protection Flight, using NFPA 10, determines the type of extinguisher required for the associated hazards.

Table 4-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
2. Aircraft outside of hangar or shelter with no servicing being conducted.	
a. UH-1, UH-60, O-2, U-2, F-5, T-38, OV-10, C-12, C-21, C-27, C-29, T-1, T-33, A/T-37, and T-41.	One Halon 1211 extinguisher per three aircraft. ATC aircraft require one per two aircraft.
b. F-4, A-7, C-7, A-10, F-15, F-16, F-22, T-39, H-53, F-111, F-117A, C-123, C-131, and C-141.	One Halon 1211 extinguisher per two aircraft.
c. B-1, B-2, C-17, C-20, DC-9, DC-10, T-43, B-52, C-130, C-141, E-3, KC-135, B-727, B-767, L-1011, and MD-90.	One Halon 1211 extinguisher per aircraft.
d. C-5 and E-4.	Two Halon 1211 extinguishers per aircraft.
e. Alert Aircraft: UH-1, O-2, U-2, F-5, T-38, OV-10, C-12, C-21, C-29, T-33, A/T-37, T-41, F-4, A-7, C-7, A-10, F-15, F-16, T-39, H-53, F-111, F-117A, C-123, C-130 and C-141.	One Halon 1211 extinguisher per aircraft.
f. Alert Aircraft: (Except DC-9 Series used for medical evacuation, refer to entry 3i. or 3j. when passenger(s) are on board.) B-1, B-2, C-5, C-17, DC-9 Series, DC-10 Series, T-43, B-52, C-130, C-141, E-3, E-4, and KC-135.	Two Halon 1211 extinguishers per aircraft.
3. Aircraft outside of a hanger or shelter being serviced.	
a. No powered support equipment being operated.	One Halon 1211 extinguisher per aircraft located in the fuel servicing safety zone (FSSZ). C-5 and E-4 require two per aircraft.
b. Powered support equipment being operated. (See paragraphs 5-4d., 5-7h., and 5-26a.)	One Halon 1211 extinguisher located in the FSSZ of the aircraft. During fuel servicing, the use of aircraft APU/GTC without integral fire suppression capability will require that the Halon 1211 extinguisher be positioned in the FSSZ and readily available to protect both the aircraft and APU/GTC exhaust port area.
c. Cargo aircraft with nuclear weapons aboard.	One Halon 1211 extinguisher per aircraft located in the FSSZ. Additionally, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be positioned at the aircraft.
d. Integrated Combat Turnaround: Simultaneous refueling, munitions loading/unloading, external fuel tank loading/unloading, and other specified maintenance activities with all engines shut down. (See paragraph 7-5a.)	In addition to the requirements of 3a. or 3b. as applicable, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be on flight line standby. It will be positioned for optimum response as determined by Base Fire Chief.

Table 4-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
e. Hot refueling: The transfer of fuel into the fuel tanks of an aircraft with one or more engines on an aircraft operating with or without munitions on board. (See paragraph 7-6.)	One Halon 1211 extinguisher positioned between the refueling equipment and the refueling supervisor's position. In addition, either a fixed or skid mounted AFFF system discharging through oscillating nozzles. An aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) may be substituted for the AFFF system. The aircraft rescue and fire fighting vehicle must be on standby just outside the FSSZ.
f. Multiple hot refueling operations.	Same as 3e. When an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) is used, it will be positioned for optimum response to the respective aircraft as determined by Base Fire Chief.
g. Hot Integrated Combat Turnaround: Simultaneous refueling, munitions loading/unloading, external fuel tank loading/unloading, and other specified maintenance activities with engine(s) operating. (See paragraph 7-5b.)	Same as 3e. or 3f. as applicable.
h. Concurrent fuel servicing of aircraft without passengers. (See Section 6.)	One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be capable of responding within three minutes when only one aircraft.

Table 4-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
NOTE Fire department shall be alerted at least 15 minutes prior to starting concurrent servicing operations.	is involved. When two or more aircraft are being concurrently serviced at different locations, the ARFF vehicle will be positioned for optimum response to the respective aircrafts as determined is involved by the Base Fire Chief.
i. Concurrent fuel servicing of aircraft with passengers, (Commercial airports exempt). (See Section 6.)	One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, when servicing with JP-4 or Jet B Fuel, a major aircraft rescue and fire fighting vehicle (P-2/4/15/19/23) will be positioned at the aircraft when only one aircraft is involved. When two or more aircraft are being concurrently serviced at different locations, the aircraft rescue and fire fighting vehicle will be positioned for optimum response to the respective aircrafts as determined by Base Fire Chief.
NOTE Fire department shall be alerted at least 15 minutes prior to starting concurrent servicing operations. The number of passengers remaining on board aircraft shall be indicated.	
j. Concurrent servicing of medical evacuation flights with passengers/patients on board. (See Section 6.)	One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, when servicing with JP-4 or Jet B Fuel, a major aircraft rescue and fire fighting vehicle (P-2/4/15/19/23) will be positioned at the aircraft.
k. Defueling when an aircraft has a fuel leak, is damaged from a fire or impact, defueling into open containers or drums, defueling where safe distance criteria cannot be met (See paragraph 5-12h.)	One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be on standby just outside the FSSZ.
l. Rapid defueling of KC-135 aircraft. (See paragraph 5-13.)	One Halon 1211 fire extinguisher for each SPR connection location being used. If the wing tip separation is less than 50 feet, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be positioned at the aircraft.
4. Aircraft serviced in flow-through revetment. (See paragraph 5-23.)	Servicing in flow-through revetments requires the same fire protection as servicing conducted on the ramp. (See 3a. through 3k.)
5. Aircraft parked inside hardened aircraft shelters (HAS).	One Halon 1211 fire extinguisher inside each shelter being used.
a. Aircraft fuel servicing in HAS. (See paragraph 5-20a.)	One Halon 1211 fire extinguisher inside each shelter being used.

Table 4-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
b. Integrated combat turnaround in HAS.	Two Halon 1211 (150 lb) extinguishers. The extinguisher closer to the aircraft fuel vent should be manned. Additionally, one aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) per shelter area must be on standby. It will be positioned for optimum response as determined by the Base Fire Chief.
c. Hot integrated combat turnaround in HAS.	Two Halon 1211 (150 lb) extinguishers. The extinguisher closer to the aircraft fuel vent should be manned. Additionally, an installed fire suppression system is required. If an installed fire suppression system is not available, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be substituted at each Hot ICT shelter. The aircraft rescue and fire fighting vehicle will standby just outside the FSSZ and the HAS aircraft entry door(s) must remain fully open.
d. Hot refueling in HAS.	Two Halon 1211 (150 lb) extinguishers. The extinguisher closer to the aircraft fuel vent should be manned. Additionally, an installed fire suppression system is required. If an installed fire suppression system is not available, an aircraft rescue and fire fighting vehicle (P-2/4/13/15/19/20/23) will be substituted at each hot refueling shelter. The aircraft rescue and fire fighting vehicle will standby just outside the FSSZ and the HAS aircraft entry doors must remain fully open.
e. Aircraft double-stuffed.	Two Halon 1211 (150 lb) extinguishers. Extinguishers will be positioned for optimum response to either aircraft depending upon particular operations(s) being conducted.
6. Aircraft parked inside alert shelters. (See paragraph 5-15.)	Apply the same fire protection as used for hardened aircraft shelters.
7. Hydrazine leak or spill. (See paragraph 5-41.)	Notify Job Control. Implement base formal contingency plan in accordance with AFOSH Standard 48-8. Refer to paragraph 5-41 of this technical order for further information.
8. Wet wing defueling. (See paragraph 7-19.)	Four, 80 BC, dry chemical extinguishers (Army supplied).
9. Aircraft serviced inside A/F 37T10/11 Hush Houses. (See paragraphs 5-54 and 5-55.)	One Halon 1211 fire extinguisher inside the hush house being used.
10. Aircraft being loaded/unloaded with non-nuclear munitions using -33-1-2 procedures with/without powered support equipment.	
a. Outside hangar or shelter.	Same as 2a, 2b or 2c as applicable.
b. Flow-through/three-sided revetment.	One Halon 1211 fire extinguisher located within each revetment being used.

Table 4-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
c. Hardened Aircraft Shelter (HAS).	One Halon 1211 fire extinguisher inside each shelter being used.
NOTE • Fire department standby vehicle is not required when the operation involves the simulation of refueling. • The fire department standby requirements contained in this TO apply for normal day-to-day operations. Under conditions of actual combat, actual contingencies or emergencies, and MAJCOM directed and approved exercises, ICT operations may be conducted with only two 150 pound Halon 1211 portable fire extinguishers. • For any operations being performed in SIMULATED hardened aircraft shelters (HAS), the fire protection equipment requirements will be the same as for those operations being conducted outside a hangar or shelter.	
11. Multiple source refueling.	One Halon 1211 fire extinguisher for each side of the aircraft being serviced.

4-21. **DISTANCE CRITERIA.**

4-22. Use table 4-2 to determine safe distances between parking areas and fueling operations.

Table 4-2. Distance Criteria Between Parking Areas and/or Fueling Operations (Distance in Feet)

	Aircraft Parking Areas/Uninhabited Buildings	Taxiing Aircraft	Inhabited Buildings	Mass Refueling Unit Parking Area
Mass Refueling Unit Parking Area	100/50	50	100**	N/A
Hot Refueling	200***	50*	200***	200
Rapid Defueling with JP-4	50	50	200	200
Rapid Defueling with JP-5, JP-7, JP-8, and JPTS	50	50	200	200

NOTE

- Distance criteria is measured as the closest distance between any part of an aircraft and building or facility involved. For parking areas, measure from the closest authorized parking positions. In many cases, jet blast, local terrain, and other factors will require increased distances to insure safety.
- Hardened Aircraft Shelters as shown in figure 5-1 are not considered to be either Inhabited or Uninhabited Buildings for the purpose or application of this table.

*Part of an aircraft may pass within 50 feet of a hot refueling operation as long as the operating engine(s) of the taxiing aircraft do not penetrate the 50-foot criteria.

**For existing parking areas, the distance may be modified on the basis of local conditions, however, the separation distance shall not be reduced below 50 feet.

***For E-4B aircraft, the distance from the wingtip can be reduced to 100 feet.

SECTION V

FLIGHTLINE SERVICING OPERATIONS

5-1. FUEL SERVICING.

5-2. Safe fuel servicing depends on keeping fuels in controlled areas, not allowing spillage, and in keeping all ignition sources away from designated servicing areas.

5-3. POWERED SUPPORT EQUIPMENT (SE).

Powered support equipment required for aircraft servicing within the fuel servicing safety zone must meet the following safety requirements:

a. The engine air intake shall be equipped with an approved flame arrestor (or an air cleaner with integral flame arrestor), installed and capable of preventing emission of flame from the intake side of the engine in event of backfiring.

b. When one is provided, the vehicle engine fuel system filter and sediment bowl in the engine fuel filtering system shall be of steel or material of equivalent fire resistance.

c. The engine exhaust system shall be located and installed to prevent hazard of fire in the event of:

(1) Leakage of fuel from the vehicle fuel tank or fuel system.

(2) Leakage from the carburetor and other fuel dispensing components of the vehicle.

(3) Spillage of fuel during the servicing of an aircraft.

d. Deleted.

e. Vehicle lighting and electrical equipment shall be as follows:

(1) All wiring shall be insulated, supported and protected against abrasion. Terminals shall be attached with snap or screw-type connections. Wiring shall be sized to provide the required current carrying capability and mechanical strength. All circuits shall have overcurrent protection.

(2) Spark Plugs and other terminal connections shall be insulated to prevent sparking in the event of contact with conductive materials.

(3) Starting motors, alternators, generators, wiring, connectors and electrical control equipment shall be as required by applicable military specifications and standards.

(4) Electrical service wiring between the tractor and cargo tank on a semi-trailer vehicle shall be of the heavy-duty service type. The cable shall mate with a multi-connector plug terminal mounted on the cargo tank. The connector shall have a positive engaging device (e.g., twist-lock or screwed coupled collar).

(5) Lights and lamps shall be of the enclosed and gasketed type which are of weather-tight construction. Electrical wiring shall be in metallic raceways, aluminum sheather capable (Type ALC) or mineral insulated cable (Type MI). Other electrical components shall be in accordance with applicable military specifications and standards.

5-4. Positioning and Operation of Support Equipment. To control, position, and operate powered and non-powered support equipment used for aircraft servicing, the following requirements apply:

NOTE

Although fuel servicing filter meter carts (MH-2 Series), commonly called "Hosecarts" are support equipment (SE) by the above definition, they will be addressed separately and referenced as fuel servicing equipment.

a. All support equipment not required in servicing operations shall be shut down prior to the start of servicing. Unless required for servicing, support equipment shall not be parked under any part of an aircraft being serviced. Parking brakes shall be applied when support equipment is in position and, if necessary, because of ramp slope conditions, chocks will also be used. Chocks shall be used on wheeled support equipment that does not have operable parking brakes.

b. Operating powered support equipment shall be parked outside the fuel servicing safety zone of the aircraft being serviced and 10 feet from any aircraft not being serviced. Wind direction, ramp slope, mechanical strain on cables or ducts, and location of the fuel source are also important considerations. Exhaust outlets shall not be pointed at the aircraft when starting powered support equipment. An operator shall remain in the vicinity of operating powered support equipment at all times.

WARNING

Avoid touching exhaust manifold if doubt exists as to temperature. Serious burns may result if the manifold is hot.

c. Support equipment shall not be refueled while operating, or when exhaust manifold/piping is hot from recent operations. Support equipment shall not be started when fuel vapors are noticeably present. Do not refuel support equipment directly from aircraft draincocks.

d. A 150-pound, Halon 1211 extinguisher is recommended and shall be readily available in the immediate vicinity where powered support equipment is operating. (Refer to table 4-1.)

5-5. Driving and Parking Fuel/Water Servicing Vehicle/Equipment. Fuel servicing vehicles will not be driven or parked closer than 25 feet from aircraft unless a spotter is used to direct the vehicle. (Exception: Fuel servicing vehicles being positioned for aircraft servicing may be driven under the horizontal stabilizers of B-1, C-5, C-17, C-130, C-141, E-4, BC-25, and Boeing 747 aircraft as long as: the vehicles stay on paved surfaces; maintain at least a ten foot clearance from any portion of the aircraft; and a spotter is used.) Special attention must be given to clearances between the fuel servicing vehicle and the aircraft cargo door when open and the ramp when lowered.) Under no circumstances will the vehicle be positioned closer than 10 feet from the aircraft. (Exception: A-10, E-4B, VC-25, 747, C-27, and U-2R aircraft only, the vehicle may be within 10 feet but no closer than five feet from the aircraft in any direction. For E-4B, VC-25, and 747 aircraft, the fuel truck may be positioned as far under the wing as necessary for the fuel hose to reach the aircraft.) Except during nose-in, nose-out or double-stuff conditions in a HAS, maintain a minimum of 5 feet between fuel servicing vehicles and any portion of the aircraft. (R-11 fuel servicing vehicles when used inside hardened aircraft shelters are exempt from the minimum 5 feet clearance requirements). The hydrant servicing vehicle (HSV) with highlift platform servicing capability may be permitted under the wing of an aircraft, if this positioning is required to perform the fuel servicing operation. Always maintain a clear path from the aircraft for rapid evacuation of vehicles in an emergency situation.

a. Avoid driving vehicles or equipment directly toward parked aircraft when within 25 feet since a brake failure could result in a collision. Approach the aircraft parallel to the wings (except in instances where single point location on the aircraft requires a different approach) and with the vehicle operator's side adjacent to the aircraft.

b. Stop the servicing equipment at least 25 feet from the aircraft, uphill if possible, and move into servicing position cautiously upon signal from directing personnel. If backing is absolutely necessary to approach an aircraft, post a spotter and place chocks to preclude the vehicle from striking the aircraft. Back very slowly so that the chocks can stop the vehicle in case of brake failure. When a series of aircraft in a row are to be refueled and the refueler moves forward along designated 10-foot clearance markings painted on the ramp, the refueler may be moved from one aircraft to another without the use of a spotter as long as the clearance markings are visible to the refueler operator.

c. Do not drive or operate servicing vehicles in the servicing area if a fuel spill has occurred or if fuel is leaking from the aircraft. Do not use servicing vehicles which have electrical system malfunctions.

d. Chocks used with servicing vehicles may be locally manufactured:

(1) On tandem axle vehicles, chocks shall be a minimum of 20 inches long, with a 7 1/2-inch base, and 5 1/2-inch height. (See AF drawing 42D6594.)

(2) On single axle vehicles, chocks shall be a minimum of 14 inches long, with a 5 1/2-inch base, and a 3 1/2-inch height.

e. Fuel, oil, and water servicing vehicles need not be grounded. However, they must be chocked when the driver's seat is vacated.

5-6. AIRCRAFT REFUELING.

5-7. Fire and explosion hazards are always present during aircraft fuel servicing operations. Mandatory use of fuel servicing vehicle and equipment operational checklists are required. The following procedures will promote safe, standardized aircraft fuel servicing from servicing vehicles and equipment or from hydrant systems.

NOTE

Do not position vehicles with the front of the vehicle facing toward any portion of the aircraft except for aircraft rescue fire fighting vehicles located in their designated standby position. A clear path shall be maintained at all times to permit rapid evacuation of servicing vehicles and personnel in the event of an emergency.

a. Deleted.

b. Unless specifically exempted elsewhere in this TO, personnel not required to service the aircraft shall leave the fuel servicing safety zone. The

APU/GTC will not be used during fueling operations on aircraft not specifically listed in paragraph 5-26.

c. Except when the equipment uses power takeoff (PTO) to drive the pump (HSV-12 is exempt), turn off the ignition switch after the servicing vehicle or equipment is parked, brakes set, and before wheels are chocked. The fuel servicing operator is now prepared to assist in the aircraft fuel servicing operation.

NOTE

It is current manpower policy to authorize only one AFSC 2F0X1 person for the operation of fuel servicing vehicles and equipment. For physical as well as safety requirements, the fuel servicing equipment operator will require assistance when preparing for servicing. Such assistance shall be drawn form other available sources (Aircrews, Maintenance Personnel or Base Flight Personnel).

d. Deleted.

e. Deleted.

f. Bond the fuel servicing vehicle and equipment to the aircraft.

WARNING

For over the wing/open port fuel servicing, always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until after the tank cap is replaced. Failure to perform this procedure can cause a static spark at a tank fill opening.

g. For single point servicing, the fuel servicing supervisor will ensure the SPR nozzle is properely connected to the aircraft refueling receptacle. The 45 degree D-1 nozzle is acceptable for most SPR fuel servicing operations. However, the straight throat D-2 nozzle is preferred for underwing fuel servicing to minimize possible stress damage to the aircraft SPR adapter. Refer to table 5-1 for a complete list of approved/authorized single point refueling nozzles.

NOTE

Connect the SPR nozzle to the aircraft. With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking. Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. On aircraft with Refueling Teams (C-5, C-130, C-141, B-52, and KC-135), the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

h. A 150 pound, Halon 1211 fire extinguisher will be located in the FSSZ of an aircraft being serviced. (Refer to table 4-1.)

CAUTION

The fuel added during servicing may cause the aircraft to settle.

i. Workstands, ladders, and any other equipment, not required for servicing, shall be kept clear of the aircraft.

NOTE

Crew ladders that do not present an interference problem or would not cause damage to the aircraft in case of strut deflation may remain installed on the aircraft during normal refueling.

j. Connections for any auxiliary equipment (such as intercoms, auxiliary power unit, and portable refueling panels) shall be completed before starting the fuel transfer operation. Do not disconnect this equipment while fuel servicing is in progress.

WARNING

During fuel servicing, fuel vapors are forced out of the vents by the incoming fuel. An explosive vapor-air mixture normally exists in the vicinity of the aircraft fuel vent. Special care must be taken that no active ignition source is in, or enters into, this area.

k. The electrical power cables shall be of sufficient length to permit parking of the power unit at least 50 feet away, preferably upwind, from pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vent outlets.

Sixty-foot AC cable, 4 AWG, part No. MS2408-1, or DC cable, size 2, part No. C108, are recommended.

l. During aircraft fuel servicing, laptop computers, cellular telephones and portable or vehicle mounted nontactical radio equipment will not be operated within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills or fuel trucks being filled (bottom loading or from aircraft defueling).

NOTE

Radio equipment that meets the Intrinsically Safe Standard or Military Standard 810 is identified with a LOGO on the radio serial plate.

m. Deleted.

n. Service the aircraft as directed in the applicable servicing equipment technical orders, operational check-lists, and aircraft technical orders.

Table 5-1. Approved/Authorized Single Point Refueling (SPR) Nozzles, Vacuum Breaks, and Dry Break Couplers

NSN	MANU-FAC-TURER	TYPE	P/N	NOTE	HOT REFU-ELING	ICT	HOT ICT	CONCUR-RENT SERVIC-ING	SWIVEL FEATURE	45 DEG THROAT	STRAIGHT THROAT
4930-00-544-3713	CARTER	D-1	6902	#1		X		X	NO	X	
4930-00-310-4858*	CARTER	D-1	61429AGH	#3	X	X	X	X	YES	X	
4930-01-385-8946	CARTER	D-1	64349H		X	X	X	X	YES	X	
4930-00-310-4858	THIEM/ WHITTAKER	D-1	F1116ES		X	X	X	X	YES	X	
4930-01-318-1479*	CARTER	D-2	61429AGJ /64349J		X	X	X	X	YES		X
4930-01-385-8924	CARTER	D-2	64349J		X	X	X	X	YES		X
4930-01-250-7482	THIEM/ WHITTAKER	D-2	F116KN		X	X	X	X	NO		X
4930-01-032-0236	CARTER	D-2	60427WX		X	X	X	X	NO		X
NOT ASSIGNED	THIEM/ WHITTAKER	D-2	F1116ER		X	X	X	X	YES		X
4930-00-117-4726	WIGGINS	CCR	CCN101/14	#2							
4930-01-363-6449	CARTER	CCR	64017								
4930-01-040-7618	THIEM/ WHITTAKER	BOTTOM LOAD-ING	F211C	#4							
NOT ASSIGNED	CARTER	BOTTOM LOAD-ING	614458L	#4							
4820-01-013-4272	AEROQUIP	VAC BRK	AE98706E	#5	X	X	X	X			
4820-01-345-0629	CARTER VAC	44595 BRK		#5	X	X	X	X			
4820-01-059-9417	CARTER VAC	41599 BRK		#6	X	X	X	X			
4730-01-366-9406	CARTER	DRY BREAK	61154AEP	#7	X	X	X	X			
4730-01-366-7215	CARTER	DRY BREAK	61154AEH	#7	X	X	X	X			
4730-01-353-8497	CARTER	DRY BREAK	61154AEL	#7	X	X	X	X			

Table 5-1. Approved/Authorized Single Point Refueling (SPR) Nozzles, Vacuum Breaks, and Dry Break Couplers - Continued

NSN	MANU-FAC-TURER	TYPE	P/N	NOTE	HOT REFU-ELING	ICT	HOT ICT	CONCUR-RENT SERVIC-ING	SWIVEL FEATURE	45 DEG THROAT	STRAIGHT THROAT
SEE NOTE	AEROQUIP	DRY BREAK	AE985()	#8	X	X	X	X			
NOT ASSIGNED	THIEM/ WHITTAKER	DRY BREAK	F596()	#9	X	X	X	X			

NOTES:

1. Restricted from HOT and HOT-ICT unless retrofitted with crank handle part No. 210089 (ZA-12 Alloy) (NSN 5340-01-344-5505).
2. Limited to cold refueling of H-1 helicopters.
3. The Carter 61429AGH and 61429AHL are the same except the 61429AHL has short handles. No new 61429AHL nozzles will be procured for USAF use.
4. Used on bottom loading fillstands. Can be utilized as hydrant to hosecart adapter on hydrant systems equipped with 2 1/2″ bayonet adapters.
5. Limited to Carter part No. 6902 SPR nozzle (AN fitting).
6. All other approved SPR nozzles (NPT fitting).

* All parts on the Carter 61429AGH, AHL, and AGJ are interchangeable.

7. Part No. 61154AEP, 2 inch complete coupler with 40 mesh screen strainer; Part No. 61154AEH, 2 1/2 inch complete coupler with 40 mesh screen strainer; Part No. 61154AEL, 3 inch complete coupler with 40 mesh screen strainer. Each of the three Part No.'s comes as a complete coupler which will mate with Military Specification, MIL-N-5877, Type D-1/D-2 nozzles. Couplers with 40 mesh screen strainers are capable of defueling at rates in excess of 400 gallons per minute without damage to the screen and therefore the screen need not be removed for defueling.
8. Part No. AE985-17U, NSN 4730-01-015-9209, (3 inch female coupler half); Part No. AE985-17V, NSN 4730-01-034-5391, (4 inch female coupler half); and Part No. AE985-16U, NSN 4730-01-015-9208, (3 or 4 inch male coupler half) requires the use of a 100 mesh screen strainer, NSN 4730-00-432-1223, which will collapse when defueling in excess of 200 gallons per minute, therefore the screen must be removed during high flow rate defuels to avoid damage to the screen.
9. Available in 2, 2 1/2 and 3 inch sizes.

o. The fuel servicing operator will closely monitor the control panel meters and gauge system on vehicles and hosecarts during the operation and be prepared to shut down in case of a fuel leak or other malfunction.

p. For normal day-to-day fuel servicing, the servicing unit operator will hold the deadman control, unless aircraft checklists or operating procedures stipulate the aircraft refueling supervisor/ SPR monitor will hold the deadman control valve. The use of any means to defeat the deadman control capability installed on fuel servicing equipment is prohibited.

q. When refueling by hydrant system, the fuels operator will hold the remote control switch or magnet switch lanyard throughout the refueling operation.

r. When aircraft fuel servicing is complete, a servicing crew member shall close and disconnect the SPR nozzle and bonding cable from the aircraft.

s. A servicing crew member will assist the fuels equipment operator in reeling and stowing the hose on the vehicle or equipment and/or disconnect and stow the hydrant hose.

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

t. The fuels equipment operator will disconnect and remove the bonding cables.

u. Use of the Hammonds Model HT-800-1L and 4T-4A injectors (and associated carts) are authorized for adding fuel system icing inhibitors (FSII) and other fuel additives to aircraft during routine fueling operations.

5-8. **MULTIPLE SOURCE REFUELING.**

5-9. Normally, only one refueling truck at a time is used to service Air Force aircraft. However, there are situations when multitruck or truck and hydrant servicing are concurrently accomplished. Multiple source refueling is prohibited on medical evacuation aircraft when patients are on board or when patients are enplaning or deplaning.

WARNING

- Multiple fuel source servicing adds an additional risk due to the increased complexity of the operation and additional personnel and equipment required to perform the function.
- Refueling operators must continuously monitor refueling flow meters for correct indication of fuel flow. If back flow is detected, immediately stop all refueling operations.

CAUTION

When dispensing fuel from multiple vehicles and hydrants, ensure that the aircraft refueling isolation valve is in the refuel/defuel or closed position.

5-10. R-11 fuel tank trucks may be used to multiple source refuel any aircraft in the AF inventory with more than one single point refueling receptacle. Other multiple truck or simultaneous truck and hydrant refueling can be accomplished on C-5, C-17, C-18/B-707, C-137, KC-135Q/T , E-4B, B-747, C-25, DC-8, DC-10, KC-10 and L-1011 aircraft. However, for C-5, C-18/B-707, and L-1011 aircraft, multiple sources, with the exception of R-11 fuel tank trucks, cannot be used to simultaneously refuel on the same side or wing of these aircraft. Multiple source refueling also requires that:

a. Intercom contact is maintained between the fuel servicing supervisor and the fuel panel operator(s) at all times during servicing.

b. The applicable aircraft -2 technical orders contain specific instructions and checklists for accomplishing multiple truck or simultaneous truck and hydrant refueling procedures.

5-10.1. When multiple refueling trucks are located on the same side or wing of an aircraft, the vehicles must be positioned at the aircraft prior to initiating any fuel flow and remain positioned and bonded until fuel flow is terminated on all trucks on that side of the aircraft.

CAUTION

For multiple source refueling, assure both trucks are in same operational mode prior to commencing fueling operations and ensure applicable refueler T.O. guidelines are strictly followed.

5-10.2. Multiple source refueling for aircraft not listed above is authorized when the refueling sources are capable of preventing fuel from passing from one truck or hydrant through an aircraft and back into another truck.

5-11. **AIRCRAFT DEFUELING.**

5-12. Defueling is the movement of fuel from an aircraft to any external, approved container or system. Procedures listed in paragraph 5-6 concerning aircraft refueling are applicable to aircraft defueling, using vehicles/equipment or hydrant fueling systems. The following additional procedures shall be used when defueling an aircraft:

a. Prior to defueling, maintenance personnel shall drain all water from aircraft sumps. If contamination is suspected, retain a fuel sample for visual examination by fuel servicing personnel.

b. Determine the fuel grade by consulting the aircraft record. Pay particular attention to aircraft which have undergone fuel cell maintenance where leak detection dye could have been used, or for aircraft which normally use a certain grade of fuel, but which were last serviced with an alternate fuel. If in doubt, or if contamination is suspected, request a fuel test.

NOTE

Routine defueling for weight and balance, fuel load change, or maintenance, does not ordinarily require special sampling and testing.

c. Do not pressurize the vehicle or equipment hoses with the single point nozzle open and the aircraft valve in defueling position.

NOTE

Defuel suction hose extension (Pigtail) does not require bonding.

d. During defueling with the Condiesel (1981) R-9, Kovatch R-9, and Oshkosh R-11 fuel servicing vehicles verify that the high level shutoff is operational. The Kovatch R-11 has an electronic high level shutoff and does not require pretest. For all other units ensure an individual is on top of the unit to observe fuel level and signal the pump operator when the unit is full.

e. The electrical power cables shall be of sufficient length to permit parking of the power unit at least 50 feet away, preferably upwind, from fuel servicing vehicles and equipment and outside of the fuel servicing safety zone.

CAUTION

Fuel being drained from aircraft sumps into containers or bowsers shall not be allowed to free fall.

f. Fuel that cannot be evacuated by normal truck or hydrant defueling operations may be drained into a rubber pail (NSN 7240-01-150-0716 only), clean metal container or bowser. Mark the container with the grade of the product being collected and restrict to this use only. Bond metal container or bowser to aircraft during draining operations.

g. All fuel drained from aircraft sumps shall be recovered by aircraft maintenance, sampled and visual analysis performed by qualified fuels personnel. Recovery will be in accordance with TO 42B-1-23 procedures.

h. An aircraft rescue and fire fighting vehicle must be on the scene when any of the following conditions exist:

(1) Defueling an aircraft which has a fuel leak in the system or under emergency conditions resulting from damage to the aircraft from fire or impact.

(2) Defueling under conditions which require drainage of fuel into open containers or drums (other than draining residual fuel into an approved safety container or bowser following a defuel operation).

(3) Defueling an aircraft at a location where established safety distance criteria cannot be met.

5-13. **RAPID DEFUELING, KC/EC/RC-135 AIRCRAFT.**

5-14. Rapid defueling reduces time and provides a means to rapidly offload fuel from KC/EC/RC-135 aircraft at a higher flow rate than defueling systems and equipment are capable of providing. This is accomplished by operating one outboard aircraft engine, using on-board fuel transfer pumps and bypassing the defuel pumps installed in the fuel servicing systems. Rapid defueling presents hazards which are not normally encountered in normal defueling operations. Consequently, personnel who are responsible for supervising and conducting rapid defueling operations must demonstrate a thorough knowledge of all equipment and systems they operate and must have completed initial and annual MAJCOM directed proficiency certification. A 150-pound Halon 1211 fire extinguisher will be within the fuel servicing safety zone for use. The following

special precautions and instructions shall be followed when rapid defueling:

a. Rapid defueling shall not be accomplished until a System Safety Engineering Analysis (SSEA) is performed on the aircraft and fueling systems. See table 5-1 for aircraft that have been certified.

b. All rapid defueling ground crew members will be certified as competent to perform rapid defueling operations by qualified trainers/supervisors. An appropriate entry will be made on the individual's AF Form 623 (Consolidated Training Records) or other suitable or prescribed document, upon initial qualification, and annually, thereafter.

NOTE

At installations where aircraft parking space is limited and hydrant fuel pit spacing will not permit 50-foot aircraft wing tip clearance, the (aircraft to aircraft) wing tip separation can be reduced to a minimum of 35 feet. However, whenever a distance of less than 50 feet (wing tip to wing tip) is maintained an aircraft rescue and fire fighting vehicle must be at the aircraft during rapid defueling operations.

c. Intercom between the rapid defueling supervisor and the fuels equipment (2F0X1) operator shall be maintained during the entire operation.

d. The fuels operator will assume a position at the hydrant pit, hosecart or defueling unit to monitor the equipment for malfunctions. Should a malfunction occur, the rapid defueling operation will be stopped immediately.

WARNING

Personnel shall not be stationed on top of the servicing unit during rapid defueling operations.

e. Rapid defueling directly into mobile fuel servicing vehicles is an abnormal defueling procedure and is authorized only when mission requirements dictate. It is not permitted in day-to-day operations. When rapid defueling into fuel servicing vehicles, fuel will enter the vehicle through the bottom loader only (R-11 fuel serving vehicles can use the 3-inch hose reel assembly as long as the fuel flow is maintained at 175 gpm or less). Test the high-level shutoff valve within the first minute of fuel flow to assure that it is operating properly. If the high-level shutoff valve is inoperative or malfunctions, stop the operation immediately.

NOTE

Rapid defueling directly into mobile fuel servicing vehicles is authorized for KC-135A/Q aircraft supporting reconnaissance activities when accomplished according to TO 42B1-1-16 and the appropriate aircraft -2 technical order.

f. Rapid defueling shall be conducted in accordance with published aircraft and fuels equipment technical orders/checklists.

Table 5-2. Aircraft Certified For Rapid Defueling

FUEL	SERIES	SYSTEM	DATE	PREPARING ACTIVITY	USING COMMAND
JP-4	KC-135A	TYPE I	MAR 78	AFLC	SAC/NGB/AFRES
		* TYPE II	FEB 77	AFLC	SAC/NGB/AFRES
		TYPE III	FEB 83	AFLC	SAC/NGB/AFRES
		R-5/R-9/R-11	FEB 77	AFLC	SAC/NGB/AFRES
	KC-135E	TYPE I	Covered by SSEAs accomplished for KC-135A		SAC/NGB/AFRES
		* TYPE II			SAC/NGB/AFRES
		TYPE III			SAC/NGB/AFRES
		R-5/R-9/R-11			SAC/NGB/AFRES
	KC-135Q/T	TYPE I	MAR 78	AFLC	SAC
		* TYPE II	FEB 77	AFLC	SAC
		TYPE III	FEB 77	AFLC	SAC
	KC-135R	TYPE I	Covered by SSEAs accomplished for KC-135A		SAC
		* TYPE II			SAC
		TYPE III			SAC

Table 5-2. Aircraft Certified For Rapid Defueling - Continued

FUEL	SERIES	SYSTEM	DATE	PREPARING ACTIVITY	USING COMMAND
		R-5/R-9/R-11			SAC
	EC/RC-135	TYPE I	Covered by SSEAs accomplished for KC-135A		SAC/TAC/PACAF/USAFE
		TYPE II			SAC/TAC/PACAF/USAFE
		TYPE III			SAC/TAC/PACAF/USAFE
		R-5/R-9/R-11			SAC/TAC/PACAF/USAFE
	135 Series	TYPE I	JUN 79	AFLC	SAC/NGB/AFRES
		TYPE II	JUN 79	AFLC	SAC/NGB/AFRES
		TYPE III	JAN 84	AFLC	SAC/NGB/AFRES
		R-5/R-9/R-11	JUN 79	AFLC	SAC/NGB/AFRES
JP-7	KC-135Q/T	JP-7 Hydrant System	FEB 77	AFLC	SAC
		R-5/R-9/R-11	FEB 77	AFLC	SAC
		** R-2	FEB 77	AFLC	SAC
JPTS	KC-135Q/T	R-5/R-9/R-11	FEB 77	AFLC	SAC

*TYPE II modified only.

**R-2 equipped with automatic high-level cutoff.

NOTE

Fuels having characteristics less hazardous than JP-4, i.e., higher flash points, are also acceptable for rapid defueling.

5-15. **SERVICING IN AIRCRAFT ALERT SHELTERS.**

5-16. When servicing in aircraft alert shelters, perform the following:

a. Aircraft parked in Air Defense alert shelters may be fully serviced with each servicing operation being performed independently for normal day-to-day servicing operations. Aircraft parked in an Air Defense alert shelter may be fully serviced simultaneously with fuel, munitions, minimal maintenance, and aircraft preflight, if an approved SSEA is listed in table 7-1 for simultaneous operations and the procedures have been included and are followed in accordance with the appropriate aircraft technical orders. Minimal maintenance allowed during refueling is drag chute installation, munitions rack loading and any other approved minor maintenance identified in the applicable aircraft technical order. Authority to conduct aircraft servicing operations within these shelters in accordance with this technical order rests with the local commander.

b. The fuel servicing safety zone criteria shall be complied with. Refueling will not start until all nonessential personnel and equipment have been removed from the area. During servicing operations, restrictions will be placed on the entry of nonessential personnel or equipment into the servicing area. During ICTs powered support equipment, i.e., MJ-1A jammers, may pass underneath aircraft fuel vent outlets but must not stop or be parked under the fuel vent outlets during fuel servicing portions of ICTs.

c. A shelter communications system or portable radio must be available and operational. Only intrinsically safe radios can be operated within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling).

d. The fuel servicing vehicle will be positioned outside the shelter and at the maximum hose length from the aircraft. Fire protection equipment shall be as specified in table 4-1. Operations will cease during any fuel spill and will not resume until the spill has been removed or neutralized and the area has been determined safe.

e. All powered vehicles or equipment not involved in the servicing operation shall be shut down and/or parked in an area that will not obstruct the operation.

f. Needed shelter electrical systems must be activated prior to refuel/defuel operations and left unchanged. Ceiling lights may be on, but all other nonessential electrical systems must be off. Electrical convenience outlets (wall socket plugs) will not be used during fuel servicing operations.

g. Servicing shall be accomplished in accordance with applicable aircraft fuel servicing technical data.

h. The fueling supervisor shall be prepared for immediate removal of the refueling equipment where rapid evacuation and/or alert reaction may be required.

i. Shelter door positioning during refueling will be a MAJCOM option.

5-17. **SERVICING IN HARDENED AIRCRAFT SHELTERS (HAS).**

NOTE

If a HAS does not meet HQ USAF approved electrical standards of the National Electrical Code for Class I, Division 2 hazardous locations, the following conditions/restrictions apply:

- The electrical power and wall/underwing lights may be energized (left on) in second and third generation HAS when aircraft are placed on shelter centerline in either a nose-in or nose-out configuration. Electrical circuitry and switches shall be placed in their required operational positions and no changes made during fuel servicing operations.
- For first and modified first generation HAS with aircraft placed on shelter centerline in either a nose-in or nose-out configuration, all electrical power that can reasonably be de-energized as defined by MAJCOM operating procedures shall be turned off. Wall/under-wing lights may be energized (left on) if the MAJCOM is willing to accept the increase in risk by having aircraft fuel vent outlets in close proximity to the non-hazardous area electrical distribution system and potential ignition source. Positioning of electrical circuits and switches shall not be changed during fuel servicing operations. Fuel servicing pressure should not be greater than 35 psi to minimize the severity of a fuel leak, spray, or spill during these operations with an increased ignition risk potential.
- In second or third generation HAS, the placement of aircraft off centerline to support double-stuff conditions increases the level of risk for fuel servicing operations to the approximate equivalency of operations in a first or modified first generation HAS and would require the same restrictions.

5-18. Aircraft parked in hardened aircraft shelters may be fully serviced simultaneously with fuel, munitions, minimal maintenance, and aircraft preflight, if an SSEA has been approved for simultaneous operations and the procedures are included in the appropriate aircraft technical orders. Minimal maintenance allowed during refueling is drag chute installation, munitions rack loading and other approved minor maintenance identified in applicable aircraft technical orders. Authority to conduct aircraft servicing operations within these shelters in accordance with this technical order rests with the local commander. The four basic types of HAS are shown in figure 5-1. Servicing operations inside HAS present a greater degree of risk than the same operations conducted outside. Such risks are manageable providing:

a. Servicing personnel are properly trained.

b. Personnel have been briefed on the risks involved.

c. That approved procedures are followed.

5-19. **FIRE SUPPRESSION EQUIPMENT FOR FUEL SERVICING IN HARDENED AIRCRAFT SHELTERS (HAS):**

a. Two Halon 1211 (150 pound) extinguishers or suitable substitutes will be located in each shelter being used for fuel servicing operations with simultaneous power-off maintenance. The extinguisher closer to the aircraft fuel vent should be manned.

b. Fire protection requirements for the fuel servicing operations during integrated combat turnarounds (ICT) are as shown in table 4-1, item 5b. or c. as applicable.

c. During normal peacetime operating conditions shelter entry doors will be open to allow easy entry of fire department vehicles in an emergency. For hot refueling operations, all shelter aircraft entry doors will be fully open, and the fire department vehicle must be on standby just outside the fuel servicing safety zone. In war or peacetime training for wartime contingencies, all aircraft entry doors may be closed during servicing operations except as noted in paragraph 5-20b. and d.

5-20. **FUEL SERVICING PROCEDURES IN HARDENED AIRCRAFT SHELTERS (HAS).**

a. Fuel servicing vehicles may be positioned inside or outside of shelters. When positioned inside they will be backed into the shelter on the right or left side of the aircraft. Except during nose-in or double-stuff conditions, the nearest part of the fuel servicing vehicle must not be closer than 3 feet from the shelter wall or door. (R-11 fuel servicing vehicles are exempt from the minimum 3 feet clearance requirements for nose-in, nose-out, and double-stuff conditions.) Whether one or more aircraft are parked within a HAS, the FSSZ must be strictly enforced with during servicing operations.

WARNING

At the first indication of a malfunction, predesignated individuals must immediately do the following actions: (1) Cease all operations. (2) Notify the fire department. (3) Use available fire extinguishers when needed. (4) Evacuate nonessential personnel from the area. (5) Open Hardened Aircraft Shelter doors.

CAUTION

Refueler vehicle engine should not be operated more than 20 minutes when aircraft entry doors are closed. When aircraft entry doors are closed, the shelter aircraft can be refueled inside a completely closed shelter. When JP-4 issued, crew members conducting in-shelter refueling or integrated combat turnarounds with shelter doors completely closed should be limited to four per duty day and should have at least a sixty minute period of low or no fuel vapor exposure between refueling aircraft in a closed shelter.

b. Shelter aircraft entry doors may be opened or closed during fuel servicing operations at the option of the fuel servicing supervisor subject to command policy. When the doors are closed, the fuel servicing vehicle will be kept at maximum distance from the aircraft that the SPR connection and doors permit. Shelter aircraft entry doors must be fully open for hot refueling operations during peacetime (including wartime training) to allow easy entry of fire department vehicle in an emergency.

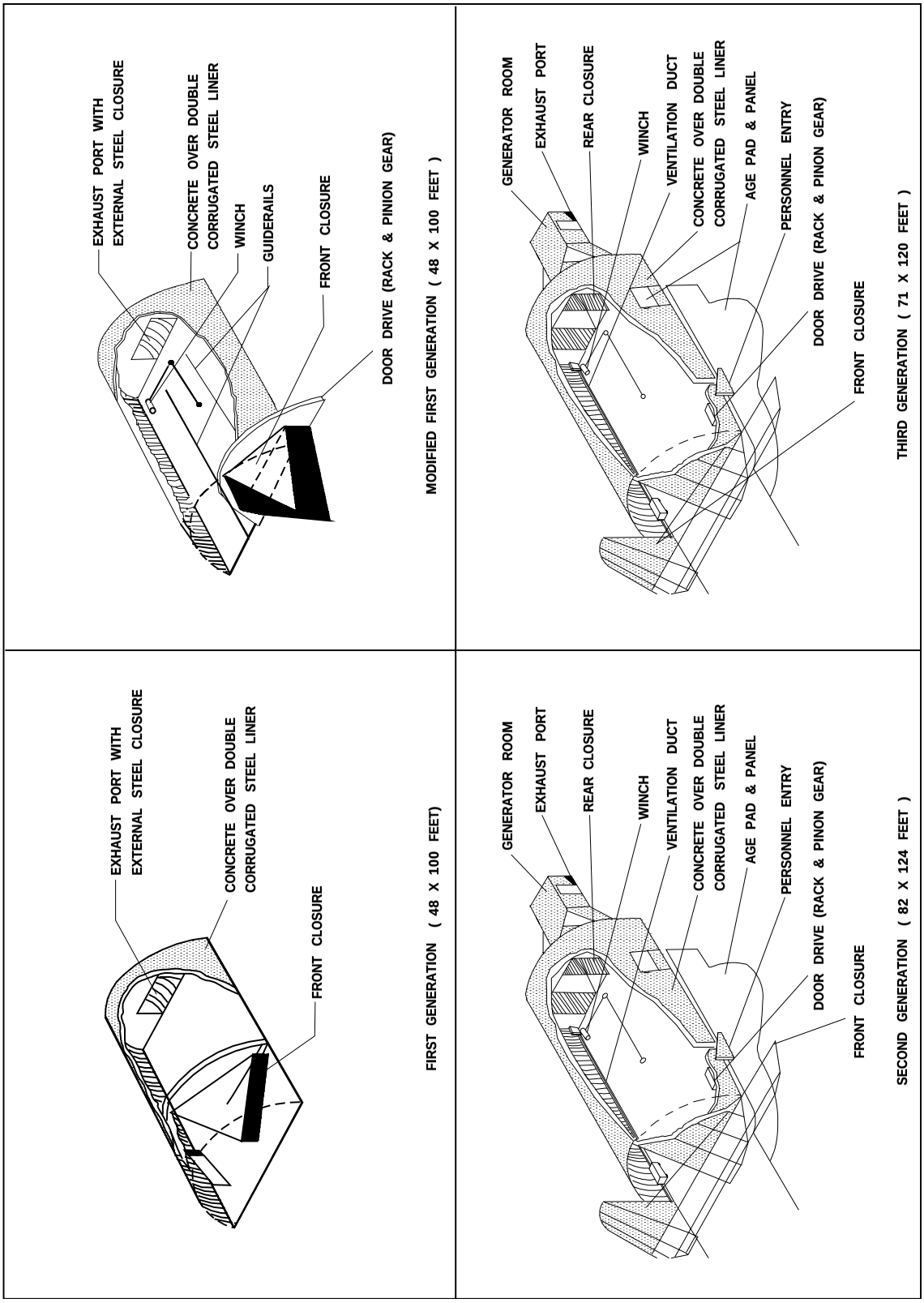

Figure 5-1. Hardened Aircraft Shelter Examples

NOTE

Physical limitations may preclude closing of first generation shelter doors.

c. Fuel servicing vehicles will not be backed into shelters until a chock is placed to stop the vehicle in case of brake failure and a spotter is in position to direct movement.

d. When powered support equipment is required for the fuel servicing operations, the equipment should be positioned outside the shelter when possible. If the equipment cannot be positioned outside, it may be positioned inside, however, all aircraft entry doors must remain open. During ICTs powered support equipment, i.e., MJ-1A jammers, may pass underneath aircraft fuel vent outlets but must not stop or be parked under fuel vent outlets during fuel servicing portions of ICTs.

e. Deleted

f. A shelter communications system or portable radio must be available and operational. Only intrinsically safe radios can be operated within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling).

g. Operations will cease during any fuel spill and will not resume until the spill has been removed or neutralized.

h. Fuel servicing vehicles or systems used within shelters must be equipped with deadman controls.

i. Servicing shall be accomplished by following applicable aircraft servicing technical data. Only those activities specifically authorized in aircraft technical orders will be performed in conjunction with aircraft servicing.

j. Portable pantographs used for fuel servicings in HAS will be placed as far as possible, without creating other hazardous situations, from in-shelter installed electrical systems. Fuel source connections to the inlet side of the GRU-17/E portable pantographs inside HAS must either be constructed of rigid metal pipe, MIL-H-26521H/J fuel servicing hose, or noncollapsible fuel servicing hose (i.e., American Petroleum Institute (API) 1529, Type C, Grade 2 (300 psi working pressure) aviation servicing hose assemblies with two-piece, one-time use internally expanded forged brass or bar stock body couplings and brass or 300 series stainless steel serrated ferrules or equivalent) for all hot refueling or hot ICT operations.

k. Aircrew members may remain in HAS during servicing operations during actual or simulated combat turnaround or combat training modes.

5-21. LIQUID OXYGEN SERVICING IN A HARDENED AIRCRAFT SHELTER (HAS).

5-22. The following applies when servicing LOX in a HAS:

a. A dedicated HAS may be used to fill converters removed from aircraft parked elsewhere. Follow procedures outlined in paragraph 5-34. Do not perform other operations in the same HAS.

b. To service the aircraft themselves in individual HAS without converters being removed, stop other operations until the LOX servicing is completed and the LOX cart removed. Follow procedures outlined in paragraph 5-34.

c. LOX cart servicing is not permitted during ICT.

d. Except for combat, the HAS doors will be positioned as follows (minimum):

(1) First generation shelters. The exhaust door and one aircraft entry door will be fully open.

(2) Modified first generation shelters. The shelter door will be open to the shelter centerline and exhaust door will be fully open.

(3) Second/Third generation shelters. One aircraft entry door may be fully opened or each aircraft entry door may be opened 10 feet (20 feet total). One exhaust door will be fully open.

e. No electrical switches will be operated.

f. No other operations or maintenance will take place in the HAS.

g. The aircraft will be at least safed for ICT if not already safed for maintenance. (For most aircraft, this means that cockpit safing and safing for applying electrical or hydraulic power is not necessary.)

h. No floor drains, traps, or other below floor areas will be within 20 feet of the LOX servicing operation. If drain channel is clean, underfloor weapons storage vault is exempt. MAJCOM may exempt F-15 first generation shelter guide rails as long as the rail channels are free of all hydrocarbons and rails are placed down in stowed position during LOX servicing (except those next to main landing gear).

i. All puddled or wet hydrocarbons are cleaned from shelter floor.

j. No non-LOX personnel or ignition sources are allowed within 20 feet of LOX servicing operation.

k. LOX cart will not be stored in HAS. LOX cart should be stored outside HAS in a separate splinter-protected location.

l. Following LOX servicing, LOX cart will be depressurized outside HAS.

m. Clean, dedicated LOX drip pans or collection devices will be used to catch LOX. Flat floor pans (when used) should be at least 3′ x 2 1/2′x 3″.

n. Aircraft specific LOX servicing procedures are used.

5-23. **SERVICING IN FLOW THROUGH REVETMENTS (FTR).**

5-24. The following procedures apply during actual or simulated combat turnaround or combat training modes when aircraft engines are not running.

NOTE

The 50-foot aircraft parking criteria does not apply to FTR since the revetment wall minimizes the probability of spreading of fire or explosion.

a. Aircraft parked in an FTR may be fully serviced simultaneously with fuel, munitions, minimal maintenance, and aircraft preflight, if an SSEA has been approved for concurrent operations and the procedures are included in the appropriate aircraft technical orders. Minimal maintenance allowed during refueling is drag chute installation, munitions rack loading and any other approved minor maintenance identified in the applicable aircraft technical order. Authority to conduct aircraft servicing operations within FTRs in accordance with this technical order rests with the local commander.

b. The fuel servicing vehicle may enter from the front or rear and service the aircraft. Other powered support equipment, i.e., MJ-1A jammers, may pass underneath aircraft fuel vent outlets but must not stop or be parked under the fuel vent outlets during fuel servicing operations.

NOTE

Deadman controls will be installed on fuel servicing vehicles used in integrated combat turnaround operations. The fuel servicing supervisor will operate the deadman controls.

c. Prior to start of fuel servicing operations, perform the following:

(1) Aircraft will be chocked.

(2) Deleted.

(3) Deleted.

(4) Fuel servicing equipment shall be bonded to the aircraft.

(5) Aircraft electrical system may be activated, but only that portion required for fuel servicing.

(6) Fuel servicing equipment operator (631X0) will be positioned at the controls of the fuel servicing equipment being used.

(7) A servicing supervisor (32XXX, 42XXX, 43XXX, or 462XX) will control fuel operations, area congestion and personnel entering or leaving the area.

(8) Fire protection will be maintained in accordance with table 4-1.

d. Hot refueling in a flow through revetment (FTR) will be conducted in accordance with paragraph 7-6. The following distance criteria applies:

(1) The 50-foot aircraft taxiing criteria applies to aircraft fore and aft of the FTR only. The FTR walls satisfy the 50-foot requirement to the sides of the aircraft. Parts of other taxiing aircraft may intrude the 50-foot zone provided the operating aircraft engine(s) are outside the 50-foot criteria.

(2) The 200-foot aircraft parking criteria does not apply to the FTR when a revetment wall minimizes the probability of spreading of fire or an explosion.

5-25. **APU/GTC USE DURING REFUELING.**

5-26. The aircraft APU/GTC may be used to supply electrical power for single point fuel servicing of E-4B/B-747, VC-25A, E-3, E-6A, C-130, C-141, C-5, C/DC-9, C-20, C-22/B-727, C-27, T-43, P-3, CH-53, KC/DC-10, C-137/C-18/B-707, B-737/ 757/ 767, C-17A, DC-8, L-100, L-188, L-1011, MD-11, MD 81/82/83/88/90, KC-135R/T, E-8C, C-135C (Serial No. 61-2669), B-1B (Left APU only), and B-2 (Right APU only) aircraft and contractor commercial aircraft when this procedure is approved in the carrier's manual. The APU/GTC will not be used during fueling operations on aircraft not specifically listed above. The following precautions apply during this operation:

a. If the aircraft is not equipped with an Integral APU fire fighting capability, one individual shall remain outside the aircraft within 20 feet of the APU/GTC compartment exhaust with a 150-pound Halon 1211 fire extinguisher. (Refer to table 4-1.)

b. One person shall remain located at the APU/GTC controls at all times during fuel servicing operations. The APU controls can be either in the cockpit or on an APU ground control panel. A person is not needed in the cockpit if the APU:

(1) Has automatic shutdown capability for an overheat or fire condition.

(2) Has an on-board fire extinguishing system.

(3) Has an audible fire alarm that can be heard outside the aircraft.

(4) Ground control panel has the capability to manually shutdown the APU and discharge the fire extinguishing system.

For B-1B aircraft, the APU/panel operator shall be positioned to ensure immediate access to the APU controls and fire fighting agent discharge switch.

c. Cockpit personnel, CSS or fuel servicing supervisor, and the servicing crew at the SPR panel shall be in constant voice contact to ensure shutdown of the APU/GTC in case of an emergency and to ensure discharge of the fire extinguishing agent in case of an APU/GTC fire.

d. Fuel servicing sources will not be located within 50 feet of any operating APU/GTC. An aircraft APU/GTC can be running, if authorized above, but must not be started during fuel servicing operations.

e. The APU/GTC must be started and running in a stable condition prior to pressurizing the refueling hose or pantograph.

5-27. INITIAL FILLING OPERATIONS OF AIRCRAFT WITH FOAM FILLED FUEL TANKS.

5-28. Numerous internal flash fires have occurred within aircraft blue foam filled tanks during refueling. In some cases, there were no audible sounds or immediate indications that an incident had occurred. These incidents are mainly due to electrostatic ignition of the volatile fuel/air mixture during initial filling operation. Fuel flowing through reticulated urethane foam at high velocities can generate sufficient electrostatic charge to produce incendiary spark discharges within aircraft fuel tanks. A fuel conductivity additive is now added to all JP-4 and JP-8 fuels to minimize the generation of static charges. However, initial filling must still be accomplished at a reduced flow rate when fueling new or recently repaired aircraft bladder tanks that are in a vapor-free condition. Refer to the applicable -2 series technical orders for more complete information.

NOTE

The fuel servicing supervisor shall notify the refueling operator when reduced fuel flow is required.

a. Reduced flow rate refueling procedures will be used when fuel servicing vehicles are the pumping source. When installed hydrant systems are used, only one hydrant pump will be activated. These procedures shall be followed until the tanks are full or at the level directed by the mission.

b. These procedures apply to all Air Force-owned aircraft and any non-Air Force aircraft, meeting the above fuel cell/tank conditions, being refueled on an Air Force base.

5-29. FILLING FUEL SERVICING VEHICLES FROM HYDRANT SYSTEMS.

5-30. Refueling units are sometimes filled on the flight line. This is accomplished by positioning a hose cart on an available hydrant outlet and assigning a qualified fuel specialist to fill refueling units. The distance criteria established for aircraft refueling in table 4-2 apply. Procedures established in TO 37A2-2-4-1CL-1, Appendix B, shall be followed.

5-31. OXYGEN SERVICING.

5-32. The Air Force uses several grades of oxygen, based on its purity, moisture content and whether or not it is in liquid or gaseous forms. Type II oxygen is supplied for aircrew use. Quality control procedures are outlined in TO 42B6-1-1.

a. Gaseous oxygen (O_2) is a colorless, odorless, tasteless gas, slightly heavier than air. It is not flammable; however, it will support the rapid combustion of most materials. It reacts violently with petroleum products such as jet fuel and lubricants if an energy source such as a fire or spark from static electricity is present. Gaseous oxygen must therefore be considered dangerous.

b. Liquid oxygen (LOX) is a pale blue liquid which exists in the liquid state only at an extremely low temperature (-182.50^{o}C or -297^{o}F). It is not flammable; however, it will support the rapid combustion of most materials. If an energy source is present, it reacts violently with petroleum products such as jet fuel and lubricants. Liquid oxygen must therefore be considered dangerous.

c. Oxygen servicing equipment shall be kept clean and free of moisture, oil, and grease at all times. Use only approved anti-seize tape for oxygen servicing fittings because of the temperatures, pressures, and fire hazards involved. Do not park oxygen carts in areas that are sodded, grassy, or asphalt covered. (Exception: LOX carts may be temporarily parked on asphalt, provided that drip pans, used exclusively for LOX servicing, are placed under the overflow vent of the cart.) Do not park LOX carts containing LOX in hangars, nose docks, or other buildings unless specifically designed or modified and set up for the storage and/or maintenance of such equipment. The following distance criteria for the parking or storing of LOX carts containing LOX and oxygen bottle carts containing gaseous oxygen applies:

(1) Twenty-five feet from any structures having fire resistant or non-combustible exterior walls or with automatic fire extinguishing systems.

(2) Fifty feet from any combustible structure or sources of ignition, such as heavy traffic areas, areas where equipment is in operation and smoking areas.

(3) Seventy-five feet from aircraft parking, fueling or defueling areas.

NOTE

LOX carts shall be parked with the vent valve open and transported with the vent valve closed. LOX and gaseous oxygen carts need not be grounded.

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

d. The following general guidance applies to both gaseous and liquid oxygen servicing. Specific information covering gaseous oxygen servicing is addressed in paragraph 5-33 and liquid oxygen servicing in paragraph 5-34.

WARNING

Do not allow oxygen to contact petroleum products as fire/explosion may result.

(1) Those persons not directly involved in oxygen servicing operations shall stay outside the 20-foot radius of the liquid oxygen servicing safety zone. Servicing personnel will insure that their hands, feet, clothing, etc., are clean and free of petroleum base products. In addition, servicing personnel shall wear personal protective equipment required for either gaseous or liquid oxygen servicing.

(2) Do not commence oxygen servicing if aircraft electrical systems are energized (except those required for servicing). In addition, do not perform oxygen servicing concurrent with fuel, oil, water-alcohol, hydraulic fluid, environmental fluid or hydrazine servicing or maintenance on systems containing these hydrocarbon products. Oxygen servicing connectors must be examined prior to servicing and any traces of petroleum products removed prior to servicing operations.

(3) Only qualified personnel shall operate oxygen equipment or service aircraft systems.

(4) The mobile servicing unit or bottles used to service aircraft or components shall be carefully positioned and shall not be left unattended after hook-up.

(5) Do not service aircraft with oxygen within 50 feet of taxiing aircraft (measured from the wing tip or closest point of taxiing aircraft to the pressurized oxygen servicing equipment). Engine runs shall not be conducted on aircraft parked in front of an aircraft being oxygen serviced. Aircraft parked to either side of an aircraft being oxygen serviced shall not have engine runs performed unless the closest point of the adjacent aircraft is more than 50 feet from the pressurized oxygen servicing equipment.

(6) Aircraft oxygen systems (both gaseous and liquid) shall be emptied/drained prior to entering a major maintenance cycle at either an Air Logistics Center, Contract Repair Facility, or Contract/Depot Field Team location.

5-33. GASEOUS OXYGEN SERVICING.

WARNING

- Do not direct gaseous oxygen toward body or clothing. Serious injury or death may result from the high energy of compressed gas and/or fire because of the rapid burning or explosive tendencies of organic materials in the presence of pure oxygen.
- When servicing low pressure oxygen systems, the maximum pressure regulator valve setting shall be 475 psig. A relief valve preset at 475 psig shall be installed on the low pressure side of all oxygen service carts. Carts not so equipped shall not be used.
- Make sure oxygen servicing components are completely free of petroleum based products, such as greases or solvents.
- To avoid heating by sudden compression, open and close all high pressure oxygen valves slowly. If two valves are to be opened, open the downstream valve first. Valves may be closed in any order.

NOTE

When utilizing multi-bottle oxygen servicing carts, use only one bottle at a time. Opening more than one bottle at a time could equalize all bottles opened.

a. The oxygen servicing units are equipped with two pressure gauges. One gauge indicates pressure of the servicing cylinders and the other gauge indicates the pressure of the oxygen being transferred into the aircraft. Gradually increase the delivery pressure until the gauge on the low side of the unit regulator indicates 425 psig. After the flow to the aircraft system has stopped, the gauge on the cart should indicate pressure of the aircraft system. A final check should then be made by checking the gauge at the oxygen regulator in the aircraft.

b. Eye protection (safety goggles, safety glasses with side shields, or face shield) shall be worn by personnel performing oxygen servicing at aircraft connection point.

c. On carts with a steel braided servicing hose, the hose serves as the bond between the cart and the aircraft. Use a bond wire if the servicing hose is not steel braid.

d. Personnel shall observe aircraft oxygen gauges at all times during servicing operations to prevent overfilling of tanks.

NOTE

If the aircraft oxygen system gauges can be observed to prevent overfilling while stationed at the oxygen servicing unit, such as T-37 aircraft, one person can accomplish the servicing.

e. Personnel shall be stationed at the oxygen servicing unit at all times during servicing operations to shut off unit valves immediately upon receiving a command from the personnel watching the aircraft system gauges.

5-34. **LIQUID OXYGEN SERVICING.**

5-35. Liquid oxygen servicing refers to a LOX bottle exchange on the aircraft or a LOX cart servicing operation. LOX cart servicing of an aircraft is not allowed during an integrated combat turnaround operation. For servicing with a LOX cart, the following procedures apply:

WARNING

- Do not allow LOX to contact petroleum products as fire or explosion may result.
- LOX will freeze and seriously damage human skin tissue upon contact.
- If LOX spills on asphalt or concrete expansion joint sealant, stop servicing or other operations within a 20-foot radius of spilled area. Do not walk or roll equipment over area of spill for at least 30 minutes (minimum) and until all frost and fog appearance has disappeared.

NOTE

Do not attempt to rewarm parts of the body that have been frozen by contact with liquid oxygen. Prevent further injury to frozen area. Transport immediately to the emergency room of the nearest medical facility.

a. Fire Protection. Ensure a serviceable 150-pound wheeled Halon 1211 fire extinguisher or equivalent is placed within 50 feet of the LOX servicing operation.

b. Protective Clothing and Equipment. When transferring LOX, personnel shall wear headcovering, face shield (NSN 4240-00-542-2048), gloves, leather, welder's gauntlet cuff (Federal Specification KKG486, Type II) (NSN 8415-00-268-7860) medium with gloves, cloth, work, cotton knit (MIL-G-1057E) (NSN 8415-00-964-4760) medium as an insert; or gloves, leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673), apron (NSN 8415-00-082-6108), coveralls, cotton white **(Mandatory)** (NSN 8405-00-037-9274), cuff less trousers, long sleeve shirt, jacket, **(Optional)** and shoes which fit closely around the top, with rubber soles and heels. All items shall be clean and free of grease, oil, and fuel.

NOTE

- The above NSN data is for gloves sized "medium." Other sizes may be ordered as required, but all sizes must meet the criteria of the federal specification and military specification identified above.
- A BDU cap is recommended as headcovering when LOX servicing connections are above eye level since it would afford more protection than the adjustable style cap with open back, typically worn as organizational headcovering. Mesh caps are not authorized.
- The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welders gauntlet cuff leather gloves or leather gloves specified above.
- A leather boot approximately 8 inches in height with close fitting top and neoprene sole and heel is recommended, since LOX spills normally subject one's foot area to a freeze burn exposure hazard. This type footwear when equipped with a hard protective toe area is generally classified as a safety shoe or boot.

c. The LOX cart servicing hose provides the bond between the cart and the aircraft.

WARNING

Drip pans shall be kept clean and not be utilized for any purpose other than LOX servicing. Any residual LOX in drip pan should be allowed to boil off and not be poured off.

d. Service area shall be well ventilated, free of oil, grease, and fuel vapors.

e. A drip pan shall be placed under oxygen overflow vents to prevent contact of the LOX with oil or grease which may be on the ramp.

f. Should a control valve become clogged with ice, thaw with water.

g. LOX servicing equipment should be purged to make sure no moisture is introduced into a liquid oxygen system and there is no moisture in or on filler fittings, nozzles, or valves where it may enter the aircraft system during servicing operations. When servicing several aircraft, one immediately after the other, the LOX servicing equipment need only be purged prior to first servicing operation.

h. Before filling the aircraft system, insure that the pressure relief valve on the LOX supply tank is operating properly.

i. A steady drip from the servicing nozzle aircraft filler valve connection that can be contained in a drip pan is acceptable. The drip can sometimes be eliminated by holding the hose, thereby removing the downward tension from the connections.

j. Leaks which result in LOX running down the servicing nozzle or the side of the aircraft or which result in LOX spraying from the connections are dangerous. Leakage from any component or connection is a potentially dangerous situation.

NOTE

Present aircraft liquid oxygen servicing connections cannot be made absolutely leak tight because of basic design deficiencies. Valves should not be discarded solely because of leaking connections. Perform a leak check on the female filler valve in accordance with TO 37C2-4-6-13 or TO 37C2-4-6-21 as appropriate.

k. The oxygen servicing unit shall be disconnected from tow vehicle and located at the maximum distance from the aircraft permitted by the hose length. Hoses shall be kept free of kinks and sharp bends at all times. LOX hoses shall be drained and capped immediately after use.

5-36. NITROGEN SERVICING.

5-37. Nitrogen is used in pressure-operated equipment to expel other gases from their cylinders and for purging tubes and lines. Quality control procedures are outlined in TO 42B7-3-1-1.

a. Gaseous nitrogen (N_2) is a colorless, odorless, tasteless gas, slightly lighter than air. It is inert and does not react with other substances nor will it support combustion.

b. Liquid nitrogen (LIN) is a colorless, odorless liquid which exists in the liquid state only at extremely low temperature (-196°C or -320.8°F).

c. The following general guidance applies to both gaseous and liquid nitrogen servicing. Specific information covering gaseous nitrogen servicing is addressed in paragraph 5-38 and liquid nitrogen servicing in paragraph 5-40. It is not necessary to ground or bond nitrogen servicing carts.

(1) Those persons not directly involved in nitrogen servicing operations should stay outside a 20-foot radius of the servicing point. Servicing personnel shall wear personal protective equipment required for either gaseous or liquid nitrogen servicing. Although nitrogen is an inert gas, it is advisable that servicing personnel keep their hands, feet, clothing, etc., clean and free of petroleum base products.

WARNING

- Do not direct gaseous nitrogen toward body or clothing. Serious injury or death may result from the high energy of compressed gas.
- Nitrogen can dilute and displace oxygen in a confined space or pit to a point where life support is endangered. Nitrogen shall therefore be used only in well-ventilated areas or where personnel are using self-contained breathing apparatus.

(2) Only qualified personnel shall operate nitrogen equipment or service aircraft systems.

5-38. GASEOUS NITROGEN SERVICING.

5-39. Nitrogen servicing units are equipped with two pressure gauges. One gauge indicates pressure of the servicing cylinders and the other gauge indicates the pressure of the nitrogen being transferred into the aircraft. Gradually increase delivery pressure into the aircraft system(s). After the flow to the aircraft system(s) has stopped, the gauge on the cart should indicate pressure in the aircraft system(s). A final check should then be made by checking the aircraft gauges.

a. If nitrogen gas is used to inflate aircraft tires, Class I (water pumped) nitrogen shall be used. Class II (oil pumped) nitrogen may cause an oil film to build up on the inside of the tire, soaking the rubber. If compressed air is used later to inflate the tire, a combustible mixture is produced within the tire by the oil film in contact with compressed air.

b. If the aircraft system or component pressure gauge can be observed and the service pressure can be controlled at the point of service, only one person is required to service gaseous nitrogen. If this combination does not exist, two people will

be required to service gaseous nitrogen. Safety goggles, safety glasses with sideshields, or face shield shall be worn by nitrogen servicing personnel.

c. When moving the nitrogen servicing trailer, all valves except vent valves shall be closed and shall not be opened until the trailer is in the working area.

d. The servicing hose shall never be tightly stretched to reach a connection.

e. Nitrogen servicing units or bottles shall be positioned to prevent accidental damage to the aircraft or equipment.

f. Nitrogen servicing equipment shall not be left unattended after hook-up.

5-40. LIQUID NITROGEN SERVICING.

a. Protective Clothing and Equipment. When transferring LIN, personnel shall wear headcovering, face shield (NSN 4240-00-542-2048), gloves, leather, welder's gauntlet cuff (Federal Specification KKG486, Type II, NSN 8415-00-268-7860) medium with gloves, cloth, work, cotton knit (MIL-G-1057E) (NSN 8415-00-964-4760) medium as an insert; or gloves, leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673), apron (NSN 8415-00-082-6108), cuffless trousers, long sleeve shirt, jacket, or coveralls, cotton (NSN 8405-00-037-9274), and shoes which fit closely around the top, with rubber soles and heels. All items shall be clean and free of grease, oil, and fuel.

NOTE

- The above NSN data is for gloves sized "medium." Other sizes may be ordered as required, but all sizes must meet the criteria of the federal specification and military specification identified above.
- A fatigue cap is recommended as headcovering when LIN servicing connections are above eye level since it would afford more protection than the adjustable style cap with open back, typically worn as organizational headcovering.
- The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welders gauntlet cuff leather gloves or leather gloves specified above.

b. It is not necessary to ground or bond nitrogen servicing carts.

c. Liquid nitrogen (LIN), when exposed to the atmosphere, absorbs and liquifies oxygen. If the surface of the LIN is slightly bluish, it is to be considered contaminated with oxygen. In this case, the LIN shall require the same handling procedures as LOX.

WARNING

Drops or splashes of LIN will freeze skin tissue.

NOTE

Do not attempt to rewarm parts of the body that have been frozen by contact with liquid nitrogen. Prevent further injury to frozen area. Transport immediately to the emergency room of the nearest medical facility.

d. When LIN is being transferred from one container to another, the receiving vessel shall be filled as slowly as possible to minimize the thermal shock that occurs when any material is quickly cooled.

e. When moving the LIN servicing unit, all valves, except vent valves shall be closed and shall not be opened until the unit is in the working area.

f. LIN servicing units shall be positioned to prevent accidental damage to the aircraft or equipment.

g. LIN servicing equipment shall not be left unattended after hook-up.

h. Should a control valve become clogged with ice, thaw with water.

i. Insure that no moisture is introduced into a LIN system and that there is no moisture in or on fittings, nozzles, or valves where it may enter the aircraft system during servicing operations.

j. Before filling the aircraft system, insure that the pressure relief valve on the LIN supply tank is operating properly.

5-41. HYDRAZINE SERVICING.

5-42. Hydrazine is a widely used industrial chemical and is very corrosive. Hydrazine appears as a clear, oily liquid having an ammonia-like odor. Since individual sensitivity to the odor may vary, and since prolonged exposure may overcome sensory recognition, the odor cannot be relied upon as an indication or warning of overexposure.

WARNING

Skin contact with liquid hydrazine or exposure to concentrations of hydrazine vapor present a serious health hazard.

NOTE

Hydrazine is hazardous because it may enter the body via lungs (breathing), gastrointestinal tract (swallowing), or through the skin (absorption). Additionally, there is a fire hazard present with hydrazine-water mixtures. (See step c.)

a. Short Term (acute) Overexposure. If exposed to high concentrations of hydrazine for short periods, dizziness, nausea, or irritation of eyes, nose, throat, or lungs may result. Liquid contact may cause skin burns. In very high concentrations, unconsciousness may occur.

b. Long Term (chronic) Overexposure. If exposed to concentrations of hydrazine vapors above permissible exposure limits over long periods, damage to kidneys and liver may occur. Frequent skin contact with liquid hydrazine may also result in damage to kidneys and liver. A yellow discoloration of skin and eyes may be apparent. Refer to AFOSH Standard 48-8 for a summary of health effects and for guidance covering the handling and use of hydrazine.

c. Fire Hazard. The 70 percent hydrazine and 30 percent water mixture used in the F-16 EPU is a flammable mixture. Fires involving hydrazine can be fought and extinguished with common extinguisher agents. Water is the preferred agent for fire suppression.

5-43. PROTECTIVE CLOTHING AND EQUIPMENT. Air-supplied respirators are required for those operations in which engineering controls and work practices are not sufficient to reduce exposure below the permissible exposure limits. If respirators are used, they must meet the requirements of AFOSH Standards 48-1 and 48-8. Because hydrazine can be absorbed through the skin, it is necessary to wear approved clothing during those situations where there may be contact with the liquid. Protective clothing approved for handling hydrazine is discussed in TO 14P3-11-1, Handling of Missile Fuels and Oxidizers. Occupational health requirements are outlined in AFOSH Standard 48-8.

5-44. **HYDRAZINE HANDLING PROCEDURES FOR F-16 AND U-2 AIRCRAFT INFLIGHT EMERGENCIES.** If an F-16 or U-2 aircraft develops an inflight emergency, it may have to land at an airfield not equipped for F-16 or U-2 maintenance/servicing. In these situations, the EPU or ESS will be secured to prevent inadvertent ground firing. Turnaround support for the EPU or ESS will be provided by the home base or by the nearest base with EPU/ESS support capability. The F-16 is equipped with a highly reliable and quickly responsive method of developing emergency electrical and hydraulic power. A monopropellant (hydrazine) powered emergency power unit (EPU) is on board the F-16 aircraft for this purpose. The U-2 is equipped with a highly reliable method of starting the engine in flight, should it stall. A monopropellant (hydrazine) powered emergency start system (ESS) is on board the U-2 aircraft for this purpose. Hydrazine, referred to as H-70 (30 percent water and 70 percent hydrazine), is highly toxic, corrosive, and considered a Class III C combustible in terms of AFMAN 91-201. Definite hazards are associated with H-70 and shall require unique support from qualified home base personnel. The F-16 or U-2 pilot is thoroughly knowledgable of the peculiar requirements associated with H-70. Non F-16 or U-2 bases shall require support from home bases for recovery of F-16 or U-2 aircraft with an activated EPU or ESS as follows:

a. General Guidance for Recovery, Isolation, and Support of Aircraft After In-Flight Operation of the EPU. In-flight operation of the EPU, as the result of electrical, hydraulic, or engine failure will normally result in the declaration of an in-flight emergency (IFE). Declaration of an IFE, for these reasons, is a positive indication that the EPU has operated in the hydrazine mode. After landing, the aircraft shall be taxied clear of active runway(s) into an area of isolation, pending hydrazine system integrity (H-70 leaks/spill) check.

b. At non F-16 or U-2 bases, the pilot and local base bioenvironmental engineer (BEE) shall conduct a system integrity check as follows:

(1) Inspect the EPU overboard vent line (located at the lower fuselage, center of MLG doors at forward most portion), the area surrounding the EPU compartment, and the ground beneath for hydrazine leakage (clear oily liquid).

(2) Inspect the area around the ESS to include the H-70 detector pellet for evidence of leakage, and the ground beneath for hydrazine leakage (clear oily liquid).

WARNING

Due to the toxic characteristics of hydrazine, personnel testing liquids for confirmation of hydrazine shall be equipped with self contained breathing apparatus as well as apron, gloves, and boots. Failure to comply with this WARNING could result in personal injury or death.

(3) Fire department personnel, equipped in full protective equipment, or equivalent may use Micro-Essential Laboratories litmus (PH) paper, catalog number 46, located in the map case in the cockpit of each F-16 or U-2, to determine if the suspect liquid is in fact hydrazine. If the litmus paper turns purple, assume the liquid is hydrazine.

(4) If no leak is noted or a leak is confirmed as not hydrazine, as determined above, the pilot will contact home base and request turn around instructions.

5-45. TRANSIENT F-16 BASES/U-2 ENROUTE SUPPORT. Transient support will involve only confirmation of the status of the EPU or ESS system (leaking or not leaking) and, if leaking, isolation and containment to minimize harmful effects of hydrazine.

a. Air Force Bases - Leaking EPUs or ESSs will be treated like hazardous chemical spills and handled accordingly.

b. Civilian Airports/Fields - The aircraft pilot will inform local authorities of the hydrazine leak and advise caution in approaching the aircraft and recommend being handled as a hazardous chemical spill.

5-46. HYDRAULIC AND OIL SERVICING.

5-47. In addition to the requirements outlined in aircraft -2 technical orders, the following shall apply to hydraulic/oil servicing of aircraft.

a. Servicing Equipment.

(1) Avoid spilling oil or hydraulic fluid on aircraft or maintenance stands.

(2) Hand operated hydraulic and oil servicing carts need not be grounded during servicing operations.

(3) Position servicing equipment as far from any portion of the aircraft as cables/hoses will allow. Maintenance stands shall be properly positioned to obtain easy access to filler caps.

CAUTION

Some USAF aircraft use a commercial hydraulic fluid which is not compatible with standard Air Force hydraulic fluids. Make sure that the aircraft technical orders and TO 42B2-1-3 requirements are followed to prevent contamination.

b. Servicing Containers.

(1) When servicing from cans or drums, ensure that cleanliness and product integrity are maintained.

(2) Keep each product segregated and properly identified.

(3) Carefully read the label before dispensing oil and hydraulic products to ensure the correct product is being used.

5-48. DRUM AND CONTAINER SERVICING.

5-49. Drum and container servicing will be in accordance with the following procedures:

a. Drum Fuel Servicing. When servicing aircraft and/or ground support equipment/vehicles from drums, the same grounding and bonding procedures used for aircraft fuel servicing shall apply. The fuel should be in the original sealed drum whenever possible. During emergencies and/or combat situations, drums may be filled with fuel by base fuels service personnel. Extreme care must be taken to ensure drum cleanliness. Drums which have previously contained chemicals, oils, or halogenated hydrocarbons shall not be used for fuel.

(1) Water and sediment are often found in fuels stored in drums. These contaminants must be removed prior to servicing from drummed stock.

(2) Aviation fuel shall be passed through a filter or filter separator prior to delivery into aircraft fuel tanks. Before delivery to aircraft or equipment, test each drum for water by using a drum sampling thief or other siphoning device.

b. Fuel Collection Containers. Containers/bowsers will be parked in a designated storage area approved by the base fire department and included in the base environmental protection plan. Parked fuel collection containers/bowsers need not be bonded unless draining or filling operations are being accomplished. Oil or hydraulic fluids will not be stored in containers/bowsers stenciled for reclaimed fuel.

5-50. WATER, WATER-ALCOHOL, AND ENVIRONMENTAL FLUID SERVICING.

5-51. Cleanliness must be maintained in water, water-alcohol, and environmental fluid servicing. Fluids must be kept free of sediment at all times. Aircraft water servicing may be accomplished simultaneous with fuel servicing or oxygen servicing provided the servicing equipment is moved into area and bonded prior to the start of any one operation. In addition, bonding wires must not be disconnected while any servicing pressurization or transfer is in progress. Fuel servicing by refueling trucks, hydrant hose carts or hydrant servicing vehicles is authorized simultaneous with water servicing unless there is a critical interference positioning problem with the servicing vehicles. There are no restrictions on servicing an aircraft with water products during maintenance, cargo handling, or passenger loading.

a. Demineralized water is used for thrust augmentation in turbojet and some turbofan engines. Quality control requirements are covered in TO 42C-1-16.

(1) Demineralized water vehicle positioning for aircraft servicing will be accomplished in accordance with procedures in TO 36A12-13-1-131CL-1. Figure 4-1 depicts positioning of the

water truck for simultaneous fuel and water servicing operations. The preferred method for all aircraft water servicing is to position the water truck either forward or aft of the aircraft, perpendicular (90°) to the direction of the fuselage.

(2) If ambient temperature is below 40°F (5°C), demineralized water will not be used in aircraft unless a system is provided to heat water supply.

(3) Water servicing may be accomplished inside hangars with DCM approval if servicing vehicle is outside hangar or if full length of servicing hose is used and hangar doors are open.

b. Environmental fluids consist of antifreeze and coolant mixture of water, demineralized water, propylene glycol and ethylene glycol. These fluids are primarily used in cold weather operations to service F/FB-111 aircraft environmental systems, and coolant for E-3A radar components.

(1) A 250-gallon A-24 servicing unit is used to service F/FB-111 aircraft. The mixture of 250 gallons consists of 12.5 gallons of propylene glycol and 237.5 gallons of demineralized water (95 percent demineralized water and 5 percent propylene glycol). Quality control requirements are covered in TO 42C-1-19.

(2) A ground liquid cooler cart, as described in TO 35E10-19-1 and TO 35E10-22-1, is used to service E-3A aircraft. The mixture consists of 62 percent uninhibited ethylene glycol and 38 percent reagent water (EGW).

(3) Environmental fluid servicing vehicle/cart positioning for aircraft servicing will be accomplished in accordance with procedures for positioning fuel vehicles. The fluid servicing vehicle/cart will be bonded to the aircraft before hoses are connected to aircraft.

WARNING

Aircraft alcohol vapors are toxic and adequate ventilation must be provided in areas where alcohol is handled. Never work in a confined area or space without mechanical ventilation or respiratory protection. Most alcohols are flammable liquids.

c. Water-alcohol mixtures are used for thrust augmentation in turbojet engines and for anti-detonation injection (ADI) or internal coolant in reciprocating engines. Quality control requirements are covered in TO 42C-1-16. Water-alcohol servicing vehicle positioning for aircraft servicing will be in accordance with procedures in TO 36A12-13-1-131CL-1.

5-52. **AIRCRAFT DE-ICING.** De-icing fluid can be applied to an aircraft with any or all of its engines operating as long as the following apply:

a. Personnel and equipment must remain outside the individual aircraft engine danger areas.

b. Avoid spraying any de-icing fluid into any engine intakes or aircraft ventilation or environmental control system (ECS) air inlets.

c. Do not apply de-icing fluid during any fuel servicing operations.

d. Do not apply de-icing fluid when any LOX equipment is within 25 feet. (De-icing fluids can be applied to aircraft having installed LOX converters as long as the access doors are closed.)

5-53. **AIRCRAFT TIRE SERVICING.**

5-54. The following general guidance applies to all aircraft installed tire inflation operations in excess of 50 psi.

a. Servicer shall comply with specific operating instructions and safety precautions prescribed for aircraft being serviced and inflating tools and servicing units being used.

b. Impact resistant safety goggles or impact resistant safety glasses with sideshields shall be worn by the tire servicer.

c. The nitrogen or compressed air source used for servicing shall have a serviceable regulator for controlling service line pressure.

d. Servicing with compressed nitrogen shall be done only with Class I (water pumped) nitrogen.

e. An approved, calibrated tire inflating tool with relief valve and minimum ten foot servicing hose shall be used during tire inflation.

f. Servicer shall be positioned in front or aft of tire being serviced during inflation, at full length of inflating tool's hose. Hose shall not be tightly stretched. The immediate area to either side of tire being inflated shall be clear of personnel. (See figure 5-2.)

5-55. **AIRCRAFT FUEL SERVICING IN TYPE A/F 37T10/11 HUSH HOUSES (ENCLOSED AIRCRAFT/ENGINE NOISE SUPPRESSOR SYSTEMS).**

NOTE

- Aircraft will be fully fuel serviced before being placed inside hush houses for engine test runs.
- These procedures are provided ONLY to be used on an exception basis, i.e., only after a fully fuel serviced aircraft has undergone engine test runs and was not able to be completed because of fuel depletion. These procedures are provided only for the purpose of alleviating the necessity to tow an aircraft 50 feet outside a hush house to accomplish fuel servicing before continuing the engine test runs. These procedures are NEVER to be used just for convenience's sake.
- Fuel servic ing vehicles may be positioned outside or inside of hush houses for fuel servicing operations. R-5, R-9, and R-11 fuel servicing vehicles shall only be backed into hush houses using a spotter and a pre-positioned chock. Place the fuel servicing vehicle on the right side of the aircraft and parallel to the aircraft fuselage at approximately the one to two o'clock position from the aircraft's cockpit.

5-56. In the event fuel servicing of an aircraft is required while located in a Type A/F 37T10 or 11 Hush House, the following procedures will apply:

a. All other operations in hush house will cease during the fuel servicing operation.

b. All support equipment normally used in hush house can remain in place provided electrical power is turned "OFF" and secured. All other support equipment including engine powered equipment will be removed from hush house prior to fuel servicing operations.

c. The three personnel doors located on control room side of hush house will be closed. All other doors will be "FULLY OPEN" during fuel servicing operations.

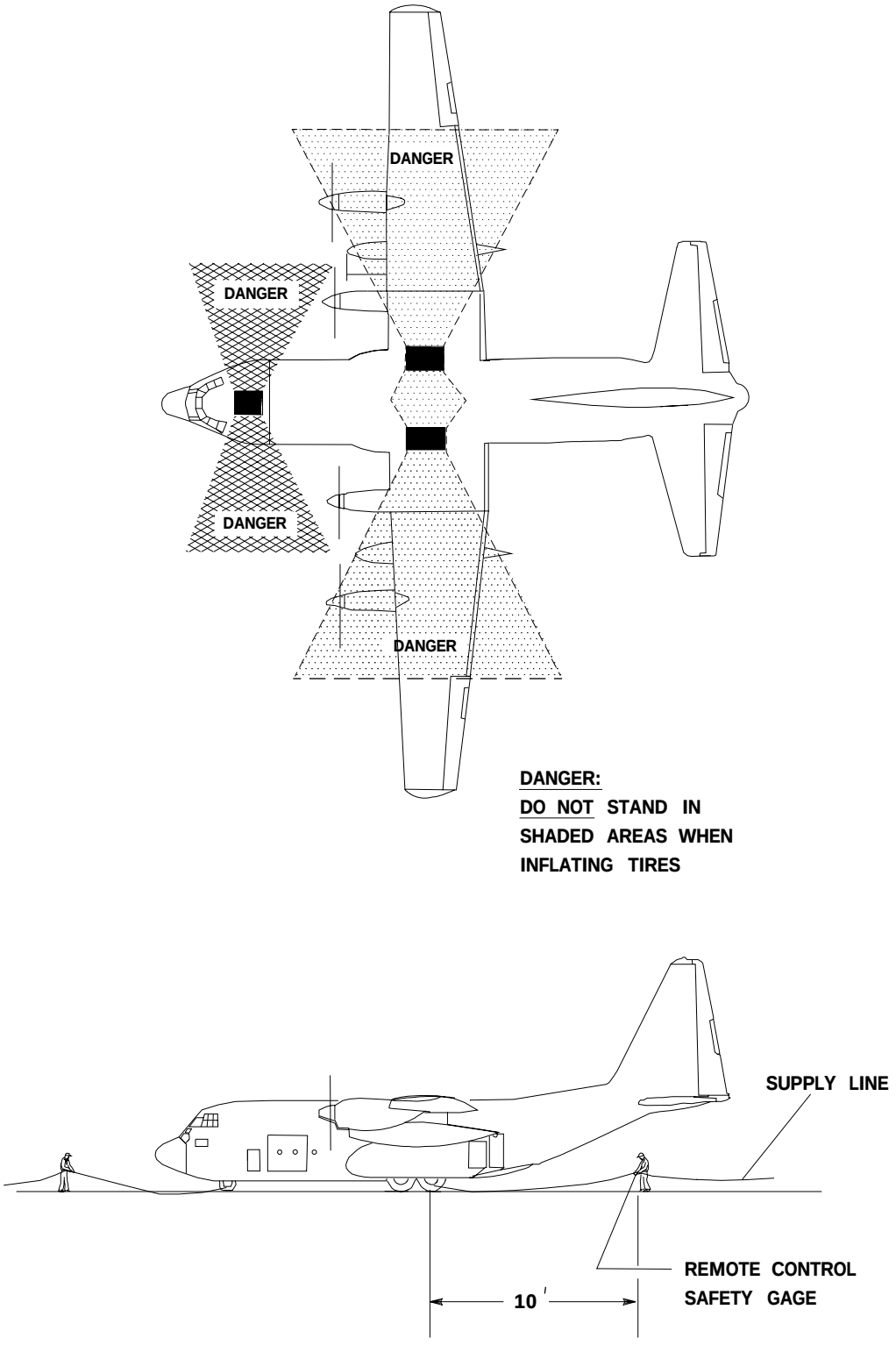

Figure 5-2. Aircraft Tire Servicing

d. All floor drains will be unobstructed.

e. Standby water flushing hoses will be readily available and maintained in good serviceable condition.

f. Disconnect the battery in the two test bay emergency lights before fuel servicing operations.

g. All electrical power will be turned "OFF" and secured to prevent activation during fuel servicing operations in hush houses manufactured by the following companies and having the following serial numbers:

(1) Aero Systems Engineering - Serial Numbers 001 thru 023.

(2) Industrial Acoustics Corporation - Serial Numbers 201 thru 207.

(3) Cullum Detuners Limited - Serial Numbers 301 thru 313.

h. The following hush houses were designed and installed with all electrical conduit and equipment in the interior of the hush house test bay and equipment room to meet the requirements of the National Electrical Code for Class I, Division 1 hazardous locations up to a height of 4 feet and Class I, Division 2 hazardous locations from 4 feet up to a height of 12 feet. Electrical power does not need to be turned "OFF" during fuel servicing operations in these following hush houses, if being maintained according to the design specifications as listed above when manufactured by the following companies and having the following serial numbers:

(1) Environmental Elements Corporation - Serial Numbers 101 thru 199 and 501 and 502.

(2) Industrial Acoustics Corporation - Serial Numbers 208 thru 299.

5-57. FUEL SERVICING EXPLOSIVES-LOADED AIRCRAFT.

5-58. An aircraft is considered "explosives-loaded" when munitions or explosives are carried either internally or externally (including nuclear weapons). The term does not include explosive components of aircrew escape systems or pyrotechnics installed in survival and rescue kits.

a. During initial generation an aircraft should normally be refueled before being loaded with either nuclear or nonnuclear munitions to reduce the severity of a mishap.

b. Fighter or bomber explosives-loaded aircraft returning from a mission may be refueled at locations meeting acceptable quantity-distance (Q-D) criteria when the munitions aboard are SAFED according to the specific aircraft munition loading manual.

c. Cargo aircraft loaded with transportation-configured explosives may be refueled at aircraft explosives cargo parking areas, commonly called hot cargo pads.

d. Fighter or bomber nonnuclear explosives-loaded aircraft may be hot refueled when authorized in Table 7-3 and the munitions aboard are SAFED according to the specific aircraft -33-1-2 munition loading manual.

e. Munitions should normally be downloaded, if practical, before defueling to reduce the severity of a mishap. Fuel loads may be adjusted on explosives-loaded aircraft to meet mission requirements. Local commanders may authorize defueling of explosives-loaded aircraft to facilitate maintenance when considered combat mission essential. (B-1B aircraft are exempt from unloading RR-170 chaff and MJU-23/B flares for defueling operations to meet mission requirements when the EXCM SAFETY PANEL (handle) is in the open position and the GROUND SAFETY LOCKOUT PLATE is installed.)

f. 30MM or smaller target practice (TP) ammunition (internally or externally loaded) may remain loaded during defueling operations provided the aircraft gun(s) are SAFED in accordance with the aircraft specific gun loading and safing procedures.

5-59. FUEL SERVICING IN HANGARS AND OTHER FACILITIES.

AFOSH STD 91-38, Hydrocarbon Fuels - General, paragraph 4.1.3, states: "Aircraft will not be fueled or defueled inside any hangar other than those facilities approved through a system safety engineering analysis (SSEA) conducted according to the instructions in TO 00-25-172." From an SSEA standpoint, aircraft fuel servicing can be done in any aircraft fuel system maintenance (fuel cell) hangars meeting the requirements of TO 1-1-3. Hardened aircraft shelters (HAS), aircraft alert shelters, and hush houses are addressed separately in this TO. A "universal SSEA" conducted by AFMC/SES in Aug 96 determined that aircraft fuel servicing operations can be conducted in hangars and similar facilities where aircraft engines are started inside and the aircraft taxies out flight ready as long as the facilities have the following provisions in good working order:

a. The facility is separated from other maintenance facilities as a separate building or does not have walls of less than a three-hour fire resistive construction.

b. The facility has a ventilation system capable of removing accumulations of fuel vapors during normal servicing. Personnel must not be exposed to fuel vapors beyond maximum exposure limits. (There are no established ventilation requirements from a fuel vapor ignition standpoint.) Individual suction devices located at the aircraft fuel vent outlets are desired, but are not required.

c. The facility must have a drainage system capable of handling and removing a fuel spill of at least 300 gallons.

d. The facility must have an installed automatic foam-water fire suppression system.

e. The facility electrical provisions must be designed for Class I, Division 1, hazardous locations below floor/grade level.

f. For servicing with high flash point fuels (JP-5, JP-8, JET A, JET A-1, and diesel), the facility must have Class I, Division 2, electrical provisions up to 18 inches above the floor/grade level, and the area within five feet horizontally from aircraft engines, auxiliary power units, fuel tanks, and fuel vent outlets and extending from the floor to a level of five feet above the upper surface of the wings, engine enclosures, and fuel tank vent outlets.

g. A separate tabletop SSEA must be required for servicing with low flash point fuels (JP-4, JET B, AVGAS, and MOGAS). As a minimum, Class I, Division 2, electrical provisions will be required from the floor/grade level up to the facility ceiling lights.

h. Other aircraft cannot be inside the facility at the same time. Support equipment will not be powered unless it is essential for the fuel servicing operation. Nonessential personnel will be removed from the facility.

i. The fuel source (e.g., truck, hose cart) can be inside the facility but must use a deadman control unit. The aircraft fuel vent outlets must be continuously visually monitored during fuel servicing.

j. There are no additional restrictions for munitions-loaded aircraft.

5-60. If a facility does not meet all of the above requirements, fuel servicing cannot be conducted unless a separate SSEA is accomplished for that facility. Table 5-3 lists specific hangars and other facilities that have been approved for aircraft fuel servicing via individual SSEAs.

Table 5-3. Specifically Approved Hangars and Other Facilities

LOCATION	FACILITY	DATE
Whiteman AFB MO	B-2 Maint Docks	Jul 88
Elmendorf AFB AK	Hangar 17	May 96
Great Falls MT	Bldg 38 (Montana ANG)	Aug 96
Eielson AFB AK	Bldgs 1277, 1288, 1335, and 1338	Aug 97
Hancock Field ANGB NY	New Aircraft Weather Shelters	Dec 00

SECTION VI

CONCURRENT SERVICING OPERATIONS

6-1. **PART I, CONCURRENT SERVICING OF USAF AND FOREIGN GOVERNMENT AIRCRAFT.**

6-2. Concurrent servicing is defined as the simultaneous servicing of fuel or oxygen with either passengers on board or the performance of minor maintenance, fleet servicing, or baggage or cargo loading/unloading. Concurrent servicing is authorized for aircraft listed in table 6-1. Additions to this table of authorized aircraft will require completion and approval of a System Safety Engineering Analysis (SSEA). Concurrent servicing will be performed using approved checklists and applicable aircraft technical orders.

WARNING

Simultaneous fuel and oxygen servicing on an aircraft is NOT authorized.

CAUTION

Defueling during concurrent operations shall be limited to the single point method (closed fuel system). C-130 and C-141 troop doors and emergency hatches on the right (SPR), side of the aircraft must be closed during concurrent servicing operations to isolate the cargo compartment from the fuel servicing safety zone.

6-3. **PERSONNEL REQUIREMENTS FOR FUEL SERVICING.**

a. The Air Force fuel servicing team will consist of the following without passengers on board:

(1) Chief Servicing Supervisor (CSS).

(2) SPR Monitor for each SPR in use.

(3) A refueling panel monitor (when the refueling panel and the SPR are adjacent to each other, one individual may monitor both).

(4) Fuel Specialists (2F0X1).

(5) Deleted.

b. The fuel servicing team with passengers on board will consist of:

(1) Chief Servicing Supervisor (CSS).

(2) SPR Monitor for each SPR in use.

(3) A refueling panel monitor (when the refueling panel and the SPR are adjacent to each other, one individual may monitor both).

(4) Passenger compartment monitor (loadmaster or passenger representative).

(5) Fuel Specialists (2F0X1).

(6) Deleted.

6-4. **RESPONSIBILITIES OF CHIEF SERVICING SUPERVISOR.**

a. Normal concurrent servicing operations.

(1) A chief servicing supervisor (CSS) shall be present during concurrent operations. The CSS will primarily be stationed at the nose of the aircraft and will monitor the wing fuel vent outlets on the opposite side of the aircraft from the SPR location. The CSS does not need to be specifically qualified to an aircraft type. For example, a C-5 CSS can also function as a C-141 CSS. The CSS does not need to be a maintenance individual. For example, a port authority, or transient alert individual can also function as a CSS. The CSS can be either a USAF employee or a contractor support employee.

(2) When servicing is performed by contract, contractor personnel functioning as the CSS must have experience comparable to that required for an Air Force CSS. Base or unit commanders shall assure that the contractor's CSS has the required experience and capability.

(3) The CSS will wear a reflective vest with the letters CSS on the front and back. The letters will be at least six inches in height and four inches wide and made of reflective material at least one-inch in width. NSN 8415-00-177-4974 satisfies this reflective vest requirement and shall be used unless otherwise specified in command directives.

(4) The CSS in concurrent operations shall also be responsible for controlling and monitoring all concurrent operations to include cargo/baggage loading/unloading, maintenance, fuel or oxygen servicing, and fleet servicing. He/she will maintain continuous intercom contact with fuel servicing team members during the entire servicing operation (excluding 2F0X1 fuels specialists). C-9 aeromedical evacuation aircraft are authorized to conduct concurrent servicing operations away from home station using an alternate method of communication when aircraft intercom capability does not exist. Alternate communication procedures such as hand signals and/or voice communication will be agreed upon by the refueling team prior to start

of the refueling operation. The refueling supervisor will ensure that the minimum number of personnel remain on the aircraft during refueling.

(5) Personnel who supervise portions of the operation; e.g. aerial port supervisor, maintenance team supervisor, or fleet service supervisor, shall coordinate each phase of their operation with the CSS and report immediately any condition that might jeopardize safety prior to beginning or during concurrent servicing operations.

(6) If concurrent operations are in progress, all personnel or their team chief will report to the CSS prior to entering the concurrent servicing area.

(7) The CSS will have full and final authority over all phases of concurrent operations and over all participating personnel, except the deployment and control of fire fighting and rescue units.

(8) During concurrent fuel servicing operations, the CSS may simultaneously perform CSS and fuel servicing supervisor duties.

(9) During concurrent oxygen servicing, the CSS will be an individual other than the person doing the actual oxygen servicing.

(10) CSS will ensure communications to the Fire Department through Job Control or the Command Post are immediately available and operational.

(11) Ensure all personnel involved in concurrent operations are briefed on the total requirements of servicing prior to commencing operations. This briefing will cover a general overview of the operation and emergency procedures.

(12) Assure fuel servicing equipment is properly bonded. Bond conductive maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations.

(13) Ensure aircraft are not concurrently refueled if the fuel jettison (dump) system was used on the previous flight unless it can be positively verified that the jettison valve(s) closed after the fuel jettison operation. Verification can be accomplished by observing cockpit indications (provided they show the true status of the jettison valves) or by physically observing the fuel to stop exiting the jettison outlet(s) upon termination of the jettison operation. If neither of these verification actions can be done, then the aircraft must not be concurrently refueled until it undergoes at least one normal refueling operation to show that the jettison valves are closed.

(14) Ensure the Fire Department is notified at least 15 minutes before starting concurrent servicing operations.

(15) Supervise the movement of equipment into and out of concurrent servicing area.

(16) Assure connections of any ground power units are completed prior to starting the servicing operations. Equipment shall remain connected until the fuel servicing is terminated.

(17) Assure all concurrent operations are performed in compliance with this technical order.

(18) Assure the proper number of fire extinguishers are available.

(19) Aircrew members may remain on board the aircraft during concurrent servicing operations as directed by the MAJCOM. When remaining on board, all safety procedures outlined in this Technical Order will be followed. Entering or exiting the aircraft shall be limited to performing essential duties associated with the concurrent servicing operation.

b. Additional requirements for CSS with passengers/patients on board.

WARNING

Voice contact must be established and maintained at all times during the fuel servicing portion of concurrent servicing operations when passengers are on board the aircraft. The aircraft intercom system should be used as the primary means of maintaining voice contact between the fuel servicing team members. If the aircraft intercom system is inoperative and cannot be used to maintain voice communications, portable hand-held radios may be used to provide voice contact subject to the following stipulations. Radios can be used within the FSSZ, however, only intrinsically safe radios can be used within 10-feet of any aircraft fuel vent outlet, fuel spill or fuel tank truck being filled from aircraft defueling.

(1) Remain in constant voice contact with loadmaster or AMC passenger representative in passenger compartment and fuel servicing team until the fuel servicing operation is completed.

(2) Passengers may enter or exit the aircraft during fuel servicing provided either: (1) a jetway is used or (2) if a mobile staircase or aircraft integral stairs are used and the fuel servicing operation is on the opposite side of the aircraft and the passengers do not come closer than 25 feet from any aircraft fuel vent outlet. For C-9 aircraft single point fuel servicing, litter patients, ambulatory patients and passengers may deplane or enplane as necessary.

c. If a hazardous situation develops, the CSS will:

(1) Stop fuel flow.

(2) Determine if evacuation of passengers from the aircraft is required.

(3) Initiate normal or emergency evacuation of the aircraft as necessary.

(4) Coordinate with aircraft rescue and fire fighting personnel as needed.

d. Ensure the fuel servicing equipment operator operates the deadman control in all concurrent servicing operations.

e. Ensure members of the maintenance servicing crew assist in setting up and removing fuel servicing equipment from the fuel servicing area.

f. Connect the SPR nozzle to the aircraft. With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking. Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. On aircraft with Refueling Teams (C-5, C-130, C-141, B-52, and KC-135), the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

6-5. **RESPONSIBILITIES OF OTHER PERSONNEL PARTICIPATING IN CONCURRENT SERVICING OPERATIONS.**

a. Normal concurrent servicing operations.

(1) Personnel who supervise portions of the concurrent servicing operations, e.g. aerial port, maintenance team, passenger service, or fleet service shall coordinate each phase of their operation with the CSS and report any condition that might jeopardize safety prior to and during concurrent servicing operations.

(2) Deleted.

(3) Personnel can use laptop computers, cellular telephones or portable or truck mounted nontactical radio equipment or cellular telephones within the fuel servicing safety zone (FSSZ). However, no battery changes for the laptop computers, cellular telephones or radios are allowed within the FSSZ and personnel will ensure the radios or cellular telephones within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) meet Military Standard 810 requirements or are intrinsically safe.

b. Additional personnel requirements for concurrent servicing operations with passengers/ patients on board. A loadmaster or AMC Passenger representative will be positioned in the passenger compartment and be in intercom contact with the CSS. They will:

(1) Deleted

(2) Ensure that personnel/passengers do not smoke during fuel servicing operations.

(3) Ensure emergency exits and aisles are unobstructed and not blocked. Escape slides will be armed.

(4) Assist in the evacuation of passengers in an emergency.

(5) Make sure a ramp or staircase is in the proper position and unobstructed to enable exit in an emergency.

(6) Aircraft personnel entry/exit doors within the FSSZ should be closed during fuel servicing operations.

c. Medical evacuation aircraft will:

(1) Have two qualified medical crewmembers in attendance in the aircraft to assist in the evacuation of patients and passengers in the event of an emergency.

(2) Ensure the exits are open as much as practical as determined by the Senior Medical Representative in consideration of weather and patient conditions. Under no condition will the exit be locked during servicing operations.

6-6. **EQUIPMENT REQUIREMENTS.**

a. Refer to paragraph 6-16a. for approved fuel servicing equipment used for concurrent servicing operations.

b. Deleted.

CAUTION

Fuel servicing forces vapors out of aircraft fuel vents and an explosive fuel-air vapor mixture may exist near the vent outlets. Ensure no ignition source is within 25 feet of the vent outlets. Assure the GPU is connected prior to starting servicing operations. Equipment shall remain connected until the servicing operations are terminated.

c. Powered AGE used in concurrent ground operations will meet the same requirements as the equipment outlined in paragraph 5-3.

d. Operating external power units will be parked at least 50 feet from pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vent outlets during fuel servicing operations. They will be placed outside the fuel servicing safety zone and when possible the unit will be positioned uphill from the servicing operation.

e. Vehicles authorized for concurrent operations inside the fuel safety zone shall maintain at least a 25-foot separation distance from the aircraft fuel vent outlets (except Boeing 747/757/767 aircraft which are acceptable for having authorized vehicles pass underneath but may not stop or be parked directly beneath the fuel vent outlets) and a 25-foot separation distance from pressurized fuel servicing system components during fuel servicing operations. All other vehicles shall remain outside of the fuel servicing safety zone.

f. Fuel servicing vehicles, associated equipment, and personnel shall maintain a clear exit path away from the aircraft to permit rapid evacuation in the event of an emergency.

g. The C-9 aircraft APU will normally be used during all single point fuel servicing operations to supply electrical and pneumatic power for the environmental control systems and life support medical equipment. If the C-9 APU becomes inoperative and the aircrew has determined that electrical and/ or pneumatic power are medically essential, suitable ground power units as outlined in paragraph 5-3 will be connected and operated as outlined in paragraph 6-6.d. These back-up power sources shall be immediately available during all medical evacuation operations.

WARNING

In the event a heating or air conditioning unit stops running while connected to the aircraft, disconnect the duct immediately.

h. When ground heaters or air conditioners are required for patient or passenger comfort, they may be used subject to the following:

(1) Electrical motors to be used within:

(a) 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) must meet the National Electrical Code (NEC) requirements for Class I, Division 1 locations.

(b) The fuel servicing safety zone but not within 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel

trucks being filled (bottom loading or from aircraft defueling) must meet the NEC requirements for Class I, Division 2 locations.

(2) Units driven by electrical motors not meeting NEC Class I, Division 2, requirements may be used providing they are stationed outside the FSSZ and upwind whenever possible. The heating and air conditioning units shall be started prior to connecting the open end of the duct to the aircraft and stopped after the duct has been disconnected.

i. An external staircase will be provided for C-5 upper deck passengers whenever the internal stairs are stowed due to cargo loading operations being conducted concurrent with fuel or oxygen servicing operations.

j. Required fleet servicing equipment.

k. Required passenger handling equipment.

CAUTION

The 40-K loader open flame heater will not be used in the concurrent servicing area.

l. Required cargo handling equipment for the specific aircraft and its cargo being on or off loaded.

m. At least four intercom headsets for C-5 and C-141, two with 100 foot cords and two with 50 foot cords. For C-130 at least three intercom headsets, one with a 75 foot cord and two with at least 50 foot cords with passengers on board.

n. Bond conductive maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations.

NOTE

The aircraft settles as fuel is taken on board. Make sure adequate clearance exists between the aircraft and maintenance stands or equipment positioned under any portion of the aircraft.

6-7. CARGO / BAGGAGE HANDLING OPERATIONS.

a. Winching cargo and/or movement of nonpalletized self-propelled vehicles/equipment into or out of aircraft in conjunction with concurrent servicing is not authorized except on the C-5, C-130, C-141, C-17, and KC-10 aircraft.

b. Passengers will not be allowed in the cargo compartment while winching of rolling stock or pallets is being accomplished.

c. Use of the winch in the cargo compartment of C-5 and C-141 aircraft is prohibited during defueling operations.

d. Cargo containing explosives, oxygen, or flammable gases or liquids shall not be loaded or unloaded during concurrent servicing operations. Under combat conditions or simulated combat exercises, loading or unloading cargo containing explosives or munitions shall be accomplished according to TO 11A-1-33.

e. Deleted.

6-8. MAINTENANCE RESTRICTIONS DURING CONCURRENT SERVICING OPERATIONS.

CAUTION

A malfunction of any component in the aircraft fuel system will require immediate shut down of the operation until the malfunction is corrected.

a. Transmitting on aircraft high frequency (HF) radios, or operating radar, radar altimeter, or SKE equipment will not be done during concurrent servicing operations. Inertial navigation system (INS) and fuel saving advisory system (FSAS) may remain energized. Satellite communications (SATCOM) radios may be operated in the transmit mode if the antenna beam is pointed at least ten degrees above the horizon.

b. Power on maintenance of electrical equipment on the exterior of the aircraft is prohibited, unless the equipment is located outside the fuel servicing safety zone.

c. Maintenance requiring the use of jacks shall not be performed with the exception of single wheel changes on multi wheel main landing gear or dual nose wheel landing gear provided the jacking is performed at the affected gear. For the C-17 aircraft, jacking can be performed on the main landing gear using the integral jacking system.

d. Maintenance in the aircraft wheel well area shall be limited to tire changes and liquid nitrogen (LIN) servicing on C-5 aircraft during concurrent servicing operations. LIN service vehicles must be positioned prior to the start of servicing operations and not moved until the servicing operations are complete.

NOTE

Maintenance and servicing of unpressurized hydraulic systems during concurrent servicing operations is authorized.

e. No flammable fluid carrying lines will be broken unless equipped with quick disconnects.

f. Maintenance or repair of the aircraft or engine fuel systems which require the opening of fuel lines, fuel tanks, or replacement of plug-in components is prohibited.

g. Power tools shall not be used during concurrent servicing operations or when bulk shipment of explosives, oxygen, or flammable gases or liquids are being loaded/unloaded.

h. Personnel not directly involved in the oxygen servicing operation will remain outside the 20-foot radius of the liquid oxygen (LOX) servicing safety zone.

6-9. **FIRE PROTECTION REQUIREMENTS.**

6-10. Fire protection requirements for concurrent servicing are:

a. One halon 1211 fire extinguisher for each SPR connection location being used.

b. At least a 15 minute notification from Job Control or the Command Post to the Fire Department prior to starting concurrent servicing operations is required to allow aircraft rescue and fire fighting vehicle positioning for a three minute response time. When two or more aircraft are being concurrently serviced at different locations, the aircraft rescue and fire fighting vehicle will be positioned for optimum response to the respective aircraft by the Base Fire Chief.

NOTE

If hazardous cargo is involved, the Fire Department will also be notified of its type and quantity.

c. With passengers/patients on board and servicing with JP-4 or Jet B fuel, a major aircraft rescue and fire fighting vehicle (P-2/4/15/19/23) will be positioned at the aircraft.

NOTE

If passengers/patients are on board, the number of passengers/patients will be given to the fire department.

d. Concurrent servicing of VC-25 aircraft with or without passengers on board requires a major aircraft rescue and fire fighting vehicle be positioned at the aircraft.

6-11. **PART II, CONCURRENT SERVICING OF COMMERCIAL CONTRACT CARRIERS.**

a. Servicing operations pertaining to these aircraft when accomplished on a USAF installation are under the direct control of the USAF and will be accomplished in accordance with the provisions of this technical order. Fuel servicing and concurrent servicing of these aircraft will be done using approved checklists. Commercial carriers authorized for concurrent servicing with or without passengers are listed in table 6-1. Cargo containing explosives, oxygen or flammable gases or liquids shall not be loaded or unloaded during concurrent servicing operations.

b. The CSS has full and final authority over all phases of concurrent servicing operations and all participating personnel. During concurrent servicing operations, the CSS is positioned close to the nose of the aircraft in order to be able to observe all operations. The CSS will wear a marking that readily identifies him/her as the CSS. The method of identification will be specified in command directives.

c. A CSS shall be provided by the USAF for all concurrent fuel servicing of contract airlift missions at military installations.

6-12. **PERSONNEL REQUIRED FOR FUEL SERVICING.**

a. The Air Force fuel servicing team will consist of the following without passengers on board:

(1) Chief Servicing Supervisor (CSS).

(2) One contractor aircraft crew member to monitor each SPR nozzle connection when government fuel is provided.

(3) One Fuel Specialist (2F0X1) per each fuel servicing unit utilized.

NOTE

The fuel servicing equipment operator will operate the deadman control in all concurrent servicing operations.

b. The fuel servicing team with passengers on board will consist of:

(1) Chief Servicing Supervisor (CSS).

(2) One contractor aircraft crew member to monitor each SPR nozzle connection and fuel vent when government fuel is provided.

(3) Deleted.

(4) Passenger Compartment Monitor.

(5) One Fuel Specialist (2F0X1) per each fuel servicing unit utilized.

NOTE

The fuel servicing equipment operator will operate the deadman control in all concurrent servicing operations.

6-13. **RESPONSIBILITIES OF CHIEF SERVICING SUPERVISOR.**

a. Normal concurrent servicing operations.

(1) A CSS shall be present during all concurrent servicing operations. The CSS will primarily be stationed at the nose of the aircraft and will monitor the wing fuel vent outlets on the opposite side of the aircraft from the SPR location.

(2) When servicing is performed by contract, contractor personnel functioning as the CSS must have experience comparable to that required for the Air Force CSS. Base or unit commanders shall assure that the contractor's CSS has the required experience and capability.

(3) The CSS shall wear clearly recognizable identification during concurrent operations. The method of identification will be specified in command directives.

(4) The CSS in concurrent operations shall be responsible for controlling and monitoring all concurrent operations to include cargo/baggage loading/unloading, maintenance, fuel or oxygen servicing, and fleet servicing. He/she will maintain intercom contact with fuel servicing team members during the entire concurrent servicing operation.

(5) Personnel who supervise portions of the operation; e.g., aerial port supervisor, maintenance team supervisor, or fleet service supervisor, shall coordinate each phase of their operation with the CSS and report immediately any condition that might jeopardize safety prior to beginning or during concurrent operations.

(6) If concurrent operations are in progress, all personnel or their team chief will report to the CSS prior to entering the concurrent servicing area.

(7) The CSS will have full and final authority over all phases of the concurrent operations and over all participating personnel, except the deployment and control of fire fighting and rescue units.

(8) During concurrent servicing operations, the CSS may simultaneously perform CSS and fuel servicing supervisor duties.

(9) During concurrent oxygen servicing, the CSS will be an individual other than the person doing the actual oxygen servicing.

(10) CSS will ensure communications to the Fire Department through Job Control or the Command Post are immediately available and operational.

(11) Ensure all personnel involved in concurrent operations are briefed on the total requirements of the servicing prior to commencing operations. This briefing will cover a general overview of the operation, any peculiarities of the aircraft being serviced, and emergency procedures.

(12) Assure fuel servicing equipment is properly bonded. Bond conductive maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations.

(13) Ensure aircraft are not concurrently refueled if the fuel jettison (dump) system was used on the previous flight unless it can be positively verified that the jettison valve(s) closed after the fuel jettison operation. Verification can be accomplished by observing cockpit indications (provided they show the true status of the jettison valves) or by physically observing the fuel to stop exiting the jettison outlet(s) upon termination of the jettison operation. If neither of these verification actions can be done, then the aircraft must not be concurrently refueled until it undergoes at least one normal refueling operation to show that the jettison valves are closed.

(14) Make sure the Fire Department is notified at least 15 minutes before starting concurrent servicing operations.

(15) Supervise the movement of equipment into and out of the concurrent servicing area.

(16) Assure connections of any ground power units are completed prior to starting the servicing operations. Equipment shall remain connected until the servicing is terminated.

(17) Assure all concurrent operations are performed in compliance with this technical order.

(18) Prior to beginning servicing operations, the CSS shall contact the commercial carriers technically qualified personnel to:

(a) Provide guidance on the duties and physical positioning of commercial contract carriers personnel during concurrent operations.

(b) Discuss any unfamiliar system characteristics or deficiencies.

(c) Determine and jointly approve the timing of any maintenance cargo or baggage loading or other activities to be accomplished during the concurrent servicing operation.

(19) Assure the proper number of fire extinguishers are available.

b. Additional requirements for CSS with passengers on board.

WARNING

Voice contact must be established and maintained at all times during the fuel servicing portion concurrent servicing operations when passengers are on board the aircraft. The aircraft intercom system should be used as the primary means of maintaining voice contact between the fuel servicing team members. If the aircraft intercom system is inoperative and cannot be used to maintain voice communications, portable hand-held radios may be used to provide voice contact subject to the following stipulations. Radios can be used within the FSSZ, however, only intrinsically safe radios can be used within 10-feet of any aircraft fuel vent outlet, fuel spill or fuel tank truck being filled from aircraft defueling.

(1) Remain in constant voice contact with personnel in the passenger compartment, the cockpit, the fuel control panel operator, and the fuel vent(s)/SPR monitor(s) until the fuel servicing operation is completed. The aircraft intercom system will be used for this purpose.

(2) If a hazardous situation develops, the CSS will:

(a) Stop fuel flow.

(b) Determine if evacuation of passengers from the aircraft is required.

(c) Initiate normal or emergency evacuation of the aircraft as necessary.

(d) Coordinate with aircraft rescue and fire fighting personnel as needed.

6-14. **RESPONSIBILITIES OF SUPERVISORY CONTRACTOR REPRESENTATIVE (SCR).**

a. The SCR will:

(1) Be under the direct control of the Air Force CSS and will respond to all CSS directions.

CAUTION

SCR will determine if aircraft fuel jettison system was used since departing last location. If the system was used, concurrent servicing operations will not be accomplished until it is determined that the jettison valves are closed.

(2) Be stationed at the refueling control panel and SPR location to connect and disconnect the fuel nozzle to the aircraft SPR for required fuel servicing. For DC-9 contractor aircraft, the fuel nozzle will be connected and disconnected by USAF personnel, such as transient alert. The fuel servicing equipment operator should not perform this task.

NOTE

For commercially contracted cargo-only aircraft where the fuel control panel/fuel system control mechanism is located on the outside of the aircraft (L-100, L-188, DC-9, and B-727), use of the aircraft intercom system by fuel servicing ground crews is not required. If any personnel (flight or ground crew members) are to remain on board the aircraft during fuel servicing operations, then voice contact must be established and maintained between the personnel remaining on board the aircraft and the fuel control panel at all times during the fuel servicing operation.

(3) Monitor fuel vent outlets on the same side of the aircraft as the SPR location and maintain constant intercom contact with CSS during concurrent servicing operations.

(4) Advise the CSS when a potential safety hazard is observed or exists. The commercial airline representative operating the fuel control panel shall terminate fuel servicing immediately when directed to do so by the CSS. Fuel servicing will not be resumed until any existing safety hazard has been corrected and the CSS directs resumption of the servicing operation.

(5) The SCR or his representative shall ensure the fuel servicing nozzle is securely locked to the aircraft by attempting to remove the nozzle with the poppet valve in the open position prior to pressurizing the system. If the SCR or designated contractor representative is able to remove the nozzle from the aircraft SPR with the poppet valve open, the fuel servicing operation will not be started. The fuel servicing unit/hydrant hose cart operator will immediately remove the nozzle from service. If the poppet valve on a SPR nozzle is closed, after the initial check and prior to pressurization, then another nozzle to aircraft lock check is required.

(6) The SCR shall provide two intercom headsets and cords, one 100-foot and one 50-foot,

for Air Force use. The 100-foot cord shall be used by the CSS. All aircraft external intercom plug-ins must be operational and usable.

NOTE

When fuel servicing with government provided fuel on a USAF (or other) installation, the USAF (or other service) shall furnish additional personnel for monitoring each fuel nozzle connection where the number of personnel required exceeds those specified in the contract.

(7) Prior to beginning concurrent servicing operations, the SCR shall establish a liaison with the CSS to:

(a) Determine specific servicing requirements, to include if unique bonding sequence is required, for the aircraft.

(b) Discuss any unfamiliar system characteristics or deficiencies.

(c) Provide guidance on the duties and physical positioning of the commercial carrier's technical personnel during the concurrent servicing operation.

NOTE

A qualified SCR shall be present for supervision and control of the commercial contractor personnel involved in the concurrent servicing operation, to include subcontractor personnel, such as caterers, cleaning crews, and the flight crew. The SCR shall provide the safety expertise as related to commercial carrier's aircraft and shall notify the CSS of any potential safety hazards.

(8) Determine and jointly approve the timing of maintenance, cargo baggage loading/unloading, fleet servicing or other activities (food service, cleaning, etc.) to be accomplished during the concurrent servicing operation.

b. Additional requirements for SCR with passengers on board.

(1) The SCR will provide one operable 50-foot headset for each SPR/vent monitor and a 100-foot or longer cord and headset for the CSS (minimum of three headsets required for Air Force use). The SCR must also ensure the fuel control panel operator has a headset and remains on intercom during the fuel servicing operation.

(2) The SCR must also ensure a member of the aircrew or a contractor representative is in intercom contact in the cockpit and cabin areas when passengers are on board during fuel servicing. This individual will be in constant intercom contact with the CSS.

(3) The SCR will ensure the aircraft external intercom plug-in jacks are in good working order. If intercom contact cannot be maintained between the CSS, fuel control panel operator(s), vent/SPR monitor(s), and the individual in the cockpit/cabin area with the passengers, fuel servicing with passengers on board will not be done.

6-15. **RESPONSIBILITIES OF OTHER PERSONNEL PARTICIPATING IN CONCURRENT SERVICING OPERATIONS.**

a. Normal concurrent servicing operations.

(1) Personnel who supervise portions of the concurrent servicing operation, e.g., aerial port, maintenance team, passenger service, or fleet service shall coordinate each phase of their operation with the CSS and report any condition that might jeopardize safety prior to or during concurrent servicing operations.

(2) Deleted.

(3) Personnel can use laptop computers, cellular telephones or portable or truck mounted nontactical radio equipment within the fuel servicing safety zone (FSSZ). However, no battery changes for the laptop computers, cellular telephones or radios are allowed within the FSSZ and personnel will ensure the radios within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) meet Military Standard 810 requirements or are intrinsically safe.

b. Additional personnel requirements for concurrent servicing operations with passengers on board.

(1) Prior to beginning fuel servicing, the flight crew will notify passengers that fuel servicing will be conducted, and that passengers have the option to deplane, if passengers remain on board ensure that restrictions on smoking and unnecessary personnel movement are enforced. Passengers are permitted to emplane or deplane anytime during concurrent servicing operations when the aircraft is using a commercial-type passenger loading bridge/stand/ramp, commonly referred to as a jetway.

(2) Qualified flight crew personnel shall be in attendance with the aircraft to ensure compliance with the above restrictions and to assist in the evacuation of passengers in an emergency. Flight crews shall ensure aircraft exits are opened, as required. Flight crews will ensure aircraft aisles remain unobstructed.

(3) Passenger service personnel shall make sure a ramp or staircase is in the proper

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position and unobstructed to enable exit in an emergency. Escape slides will be armed.

6-16. EQUIPMENT REQUIREMENTS.

a. Fuel servicing equipment approved for concurrent servicing operations:

(1) Without passengers:

(a) MH-2 hydrant hose cart being used with Type I or Type II modified hydrant systems when equipped with a magnetic KISS system or deadman control.

(b) HHT, hydrant hose truck being used with Type I, II, or III hydrant systems equipped with deadman controls.

(c) R-5/R-9 fuel servicing trucks equipped with deadman controls.

(d) Any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

(e) R-11 fuel servicing trucks when equipped with API 1529, Type C, Grade 2/3 aviation servicing hose assemblies with two-piece, one-time use, internally expanded forged brass or bar stock body couplings and brass or 300 series stainless steel serrated ferrules.

(2) With passengers on board:

(a) Tri-State hydrant hose trucks and fuel servicing trucks equipped with deadman controls and at least 50 feet of noncollapsible fuel servicing hose or MIL-H-26521H/J fuel servicing hose.

(b) MH-2 series hydrant hose carts modified with semi-hard (noncollapsible) fuel servicing hose, or MIL-H-26521H/J fuel servicing hose straight throat nozzle, and equipped with a magnetic KISS system or deadman controls.

NOTE

The modified MH-2 series hose cart will only be used when the Tri-State hydrant hose truck is not available. During peacetime operations, fuel servicing trucks equipped with collapsible fuel servicing hose will not be used for concurrent servicing while passengers are on board.

(c) Any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

(d) R-11 fuel servicing trucks when equipped with API 1529, Type C, Grade 2/3 aviation servicing hose assemblies with two-piece, one-time use, internally expanded forged brass or bar stock body couplings and brass or 300 series stainless steel serrated ferrules.

b. Deleted

c. Powered AGE used inside the fuel servicing safety zone (FSSZ) will meet the requirements outlined in paragraph 5-3.

d. Operating external power units will be parked at least 50 feet from pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vents during fuel servicing operations. They will be placed outside the fuel servicing safety zone and when possible positioned upwind from the servicing operation.

e. Vehicles authorized inside the fuel servicing safety zone during concurrent servicing operations shall maintain at least a 25-foot separation distance from the aircraft fuel vent outlets (except Boeing 747/757/767 aircraft which are acceptable for having authorized vehicles pass underneath but may not stop or be parked directly beneath the fuel vent outlets) and a 25-foot separation distance from pressurized fuel servicing system components during fuel servicing operations. All other vehicles shall remain outside of the FSSZ.

f. When ground heaters or air conditioners are required for passenger comfort, they may be used in the FSSZ subject to the following:

(1) Electrical motors to be used within:

(a) 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) must meet the National Electrical Code (NEC) requirements for Class I, Division 1 locations.

(b) The fuel servicing safety zone but not within 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) must meet the NEC requirements for Class I, Division 2 locations.

(2) Units driven by electrical motors not meeting Class I, Division 2, requirements may be used providing they are stationed outside the FSSZ and upwind whenever possible. The heating and air conditioning units shall be started prior to connecting the open end of the duct to the aircraft and stopped after the duct has been disconnected.

g. Contractor/subcontractor vehicles involved in concurrent servicing operations must comply with the standards required in TO 00-20B-5 if operation is required inside the FSSZ. Those vehicles not meeting these requirements will not be allowed in the fuel servicing safety zone. The SCR will inform the CSS of the status of contractor/subcontractor vehicles prior to the start of concurrent servicing operations.

h. If workstands are used, bond to the aircraft. Workstands shall not be moved except under the direction of the CSS.

NOTE

Maintenance stands and equipment used under the aircraft during fuel servicing operations will be positioned to ensure the aircraft is not damaged when it settles as the aircraft is fueled.

6-17. MAINTENANCE RESTRICTIONS DURING CONCURRENT SERVICING OPERATIONS.

a. Transmitting of aircraft high frequency (HF) radios or operating radar or radar altimeter is prohibited during concurrent servicing operations. Inertial navigation system (INS) and fuel saving advisory system (FSAS) may remain energized. Satellite communications (SATCOM) radios may be operated in the transmit mode if the antenna beam is pointed at least ten degrees above the horizon.

b. Power on maintenance of electrical equipment on the exterior of the aircraft is prohibited, unless the equipment is located outside the FSSZ.

c. Maintenance or repair of the aircraft or engine fuel systems which require the opening of fuel lines, fuel tanks, or replacement of plug-in components is prohibited.

d. Power tools shall not be used during concurrent servicing operations.

e. Only aircraft switches required for concurrent servicing operations will be operated.

f. Personnel not directly involved in the oxygen servicing operation will remain outside the 20-foot radius of the liquid oxygen (LOX) servicing safety zone.

6-18. FIRE PROTECTION REQUIREMENTS.

6-19. Concurrent servicing without passengers is considered a moderate risk and concurrent servicing with passengers a life risk. Fire protection requirements for concurrent servicing are:

a. One halon 1211 fire extinguisher for each SPR being used.

b. At least a 15 minute notification from Job Control or the Command Post to the Fire Department prior to starting concurrent servicing operations is required to allow aircraft rescue and fire fighting vehicle positioning for a three minute response time. When two or more aircraft are being concurrently serviced at different locations, the aircraft rescue and fire fighting vehicle will be positioned for optimum response to the respective aircraft by the Base Fire Chief.

NOTE

If hazardous cargo is involved, the Fire Department will also be notified of its type and quantity.

c. Concurrent servicing with passengers on board.

(1) One halon 1211 fire extinguisher for each SPR being used.

(2) When servicing with JP-4 or Jet B fuel, a major aircraft rescue and fire fighting vehicle (P-2/4/15/19/23) will be positioned at the aircraft.

NOTE

The number of passengers remaining on board the aircraft will be given to the fire department.

Table 6-1. Concurrent Servicing

TYPE	SSEA	CARGO	PASSENGERS	POWER-ON MAINTENANCE	APU	SERVICING OXYGEN
C-5, C-130, C-141	Nov 81	A	A	A	A	A
B-747, DC-8, DC-10	May 81	A	A	A	A	A
L-100, L-188, DC-9	Nov 83 (Tabletop)	A	L-188 only	Power-off only	A	N
B-707/C-18/C-137	Jul 84 (Tabletop)	A	A	A	A	A
KC-10	Mar 84	A	A	A	A	A
C-20/C-37	Nov 84 (Tabletop)	N/A	A	N	A	N
TR-1	Sep 84	N/A	N/A	A	N/A	A Power off only
KC-135	Jul 79 (Tabletop)	N	N	A	KC-135R Only	A
C-9	None	N	A	N	A	A
T-43	Mar 86 (Tabletop)	A	A	N	A	N
E-3	None	N	N	N	A	N
E-4B	Apr 83	N	A	A	A	A****Power-On
B-52	Mar 86 (Tabletop)	N	N/A	A	N/A	A
B-727/C-22	Mar 86 (Tabletop)	A	A	N	A	N
L-1011	Mar 87 (Tabletop)	A	A	N	A	N
C-135	Aug 87	A	A	A	KC-135R Only	A
B-737	May 90 (Tabletop)	A	A	N	A	N
C/WC-135B	Dec 90 (Tabletop)	A	A	A	N/A	A
VC-25A[1]	Jun 90	N	A	N	A	N
C-27	Oct 91	A	A*****	A	A	N
B-757(C-32)/767	Feb 93	A	A	A******	A	N
P-3 (Navy)	Mar 93 (Tabletop)	N	A	N	A	N
C-17A[2]	Sep 93	A	A	A	A	A
MD-11	Nov 93	A	A	A	A	A
DC-9, MD-81, MD-82, MD-83, MD-88, MD-90	Dec 95 (Tabletop)	A	A	N	A	A

Table 6-1. Concurrent Servicing - Continued

TYPE	SSEA	CARGO	PASSENGERS	POWER-ON MAINTENANCE	APU	SERVICING OXYGEN
B-2	Feb 94	N/A	N/A	A	A	A
VC10 (RAF)	May 00 (Tabletop)	N	N	A	A	N
B-1	Jun 99	N/A	N/A	A	A	A

[1]NOTE: Approved for only limited concurrent servicing operations (i.e., not to include oxygen servicing, galley servicing or on board mechanized baggage handling equipment).

A = Approved
N = Not evaluated (not approved)
N/A = Not applicable
A**** = Aircraft electrical power may be provided by either an external ground power unit (GPU) or by operating aircraft engine number 1 or 2 and/or the aircraft APU.
A***** = Includes litter patients
A****** = Allowed on the aircraft exterior outside the FSSZ.

[2]NOTE: When multiple source refueling with trucks, the refueling truck placed in the left rear quadrant of the aircraft will have to be placed within 10 feet of the aircraft fuselage.

SECTION VII

COMBAT OR CONTINGENCY OPERATIONS

7-1. GENERAL.

NOTE

Hot refueling and hot integrated combat turnaround (ICT) operations are no longer authorized when using MIL-H-6615 refueling hose and/or MIL-C-38404 hose end couplers. The approved replacement hose to continue hot refueling and hot ICT operations is American Petroleum Institute (API) Bulletin 1529, Grade 2/3, Type C, aviation fueling hose. The approved coupling replacements are internally expanded non-reusable hose end couplings meeting the design and performance specifications of API Bulletin 1529.

7-2. This section is divided into three parts, each providing guidance for a specific type of fueling operation. These three parts are:

a. Integrated combat turnarounds and hot refuelings performed primarily by maintenance personnel on established flightlines.

b. Aircraft to aircraft fueling operations normally performed by specially qualified aircrews and ground support personnel in forward operating areas.

c. Fuel operations using the Aerial Bulk Fuels Delivery System (ABFDS) with Alternate Capability Equipment (ACE) permit direct delivery of fuel from a modified ABFDS to a receiver aircraft/helicopter.

NOTE

For fuel servicing information on explosives-loaded aircraft, refer to paragraphs 5-56 and 5-57. For handling and maintenance instructions of explosives loaded aircraft, refer to TO 11A-1-33.

7-3. PART I, INTEGRATED COMBAT TURNAROUNDS AND HOT REFUELINGS.

7-4. INTEGRATED COMBAT TURNAROUND (ICT).

7-5. An ICT is a process by which an aircraft is recovered and relaunched in a minimum amount of time through simultaneous refueling, munitions loading/unloading, external tank loading/unloading and other specified maintenance activities. An ICT can be done with all aircraft engines shut down or with aircraft engine(s) operating (hot ICT). Specific approved procedures and safety precautions are contained in the appropriate aircraft -33-1-4 Technical Order. Additional capabilities must be evaluated through SSEA (AFI 91-202, Chapter 9, paragraph 9.7) procedures and approval given prior to performing ICT operations.

NOTE

- Deadman controls will be installed on all approved refueling equipment used in conjunction with integrated combat turnaround operations. The refueling supervisor will operate the deadman controls.
- ICT operations will not be started unless one of the following requirements is met at an individual ICT location:
- The pilot in the aircraft is in radio contact with either the tower or ground control.
- An operational base net telephone is installed.
- An operable maintenance radio is immediately available. The radio should not be operated within ten feet of aircraft fuel vent outlets during refueling operations, around known fuel spills or potential fuel vapor accumulation areas.
- A coded fire alarm notification system is installed.

a. Integrated Combat Turnaround. In an ICT, all aircraft engines are shut down. This operation was originally conceived to only be performed under emergency combat conditions. Today, ICT operations are frequently performed as part of normal day-to-day training exercises to maintain proficiency for such contingencies. In a hardened aircraft shelter (HAS), ICTs can be done on a single aircraft parked nose-in or nose-out on centerline of HAS. Two aircraft may be parked in a second or third generation shelter (double stuffing), but only one of the aircraft can undergo an ICT at a time. Refer to table 7-1 for those aircraft that have been evaluated. Refer to table 4-1 for fire protection requirements.

b. Hot Integrated Combat Turnaround. In a hot ICT, the aircraft engine(s) is operating. Hot ICTs are approved for combat operations, combat training, exercises, and evaluations as authorized

by the major command. This does not restrict simulated training operations as outlined in the modified procedures for the appropriate weapon system. Hot ICTs are not allowed for nose-in or double-stuff conditions in HAS operations.

7-6. HOT REFUELING (FUELING WITH ENGINES RUNNING).

7-7. This type of refueling requires the approval of the MAJCOM of the activity involved. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM is required. Hot refueling provides minimum aircraft turnaround times and reduces fueling personnel and equipment support requirements. However, it presents hazards which are not normally encountered in other fueling operations. Consequently, personnel who are responsible for supervising and conducting hot refueling must have:

a. A thorough knowledge of all equipment and systems they operate.

b. A thorough knowledge of and observe all safety procedures.

c. A thorough knowledge of and follow the sequential steps for each operation.

d. Undergone annual certification per command directives.

7-8. Hot refueling will not be attempted unless individual aircraft technical order guidance, checklists and appropriate individual fueling systems are available. Aircraft will not be hot refueled without fully qualified ground servicing crews. Hot refueling shall not be performed until System Safety Engineering Analysis (SSEA) validation procedures have been accomplished on the aircraft, fueling systems and facility and until the SSEA has been approved by HQ AFMC/SES. Refer to table 7-3 for those aircraft and refueling systems that have been evaluated for hot refueling operations. The use of approved refueling equipment is mandatory. Any deviation from this policy shall be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of hot refueling, the MAJCOM commander may authorize deviation from this policy. Refer to table 4-1 for fire protection requirements. A MAJCOM or MAJCOM delegated team composed of Safety, Fuels Servicing, Aircraft Maintenance, Operations, Fire Protection, and the Liquid Fuels Engineer shall certify individual hot pit refueling sites on a case by case basis. The command will provide specific guidance for site certification and personnel training/certification.

7-9. The minimum hot refueling ground crew requirements for single aircraft servicing will be in accordance with applicable hot refueling technical orders. For hot refueling two or more aircraft simultaneously with equipment such as the Type IV hot refueling system, the minimum ground crew per aircraft is as specified above plus one overall hot pad supervisor (five level or above). All hot refueling ground crew members will be certified as competent to perform hot refueling operations by qualified trainers/supervisors. An appropriate entry will be made in each individual's AF Form 623 (Consolidated Training Records) or other suitable or prescribed document, upon initial qualification and annually thereafter.

NOTE

Hot refueling personnel will not wear items of clothing or accessories that present foreign object damage potential.

7-10. HOT PAD REFUELING SUPERVISOR.

a. This individual (five level or above) has overall responsibility for the operation, assures compliance with the applicable refueling checklist and assures that aircraft entering the hot refueling area have had all live ordnance downloaded or safed in accordance with applicable aircraft technical orders. Aircraft returning from an ordnance delivery will be cleared for hot refueling by personnel qualified to "safe"the aircraft and ordnance. Personnel or equipment on the hot refueling pad will not be positioned in front of forward firing ordnance. The hot pad/refueling supervisor will brief the team members on their assignment and responsibilities considering aircraft configuration and ground conditions (i.e., attached external fuel tanks, ECM pods, chaff dispenser or pods, wind direction, positioning of aircraft, FOD potential, and emergency procedures).

b. When simultaneously hot refueling two aircraft, the hot pad refueling supervisor must coordinate the operations of each aircraft refueling supervisor and the fuels equipment operator. The hot pad supervisor will have a locally developed checklist designating his specific duties, responsibilities, and range of aircraft positions as a supplement to the specific aircraft supervisor's servicing checklist. The hot pad supervisor must remain in full view of each aircraft refueling supervisor and fuels equipment operator.

7-11. HOT REFUELING EQUIPMENT OPERATOR (REO). The REO (2F0X1) will assume a position at the refueling equipment and will observe the pressure gauges plus the hot pad and aircraft refueling supervisors and be constantly alert for a

malfunction. Should a malfunction occur, the REO shall immediately shut down the fueling operation.

NOTE

For panero type I hydrant systems (with installed gauges, valves and meter only), the Refueling Equipment Operator (REO) will monitor lateral control pit pressure gauges and crew chief will monitor pantograph.

7-12. HOT REFUELING SEQUENCE.

a. Aircraft will not be hot refueled if the fuel jettison (dump) system was used on the previous flight unless it can be positively verified that the jettison valve(s) closed after the fuel jettison operation. Verification can be accomplished by observing cockpit indications (provided they show the true status of the jettison valves) or by physically observing the fuel to stop exiting the jettison out lets(s) upon termination of the jettison operation. If neither of these verification actions can be done, then the aircraft must not be hot refueled until it undergoes at least one normal (cold) refueling operation to show that the jettison valves are closed.

WARNING

Aircraft will not be positioned such that jet exhaust is directed at another aircraft on the hot refueling pad.

CAUTION

Temperature sensitive substances (temp sticks) have caused damage to F-15 aircraft brake assembly pressure plate anti-oxidant coating and should not be used on the F-15 aircraft.

NOTE

For simultaneous hot refueling operations, aircraft will not enter the hot refueling pad unless it can immediately egress, if necessary. Fire Department must be notified whenever hot refueling is to be accomplished. Refer to paragraph 4-19 and table 4-1.

b. A hot brake check will be performed. The A-10 and F-15 aircraft are excepted because of the location, direction, and distance of the fuel vent outlets from the aircraft landing gear brake assemblies. The brake temperature should not exceed 750°F. Temperature can be measured by temperature sensitive substances (temp sticks) or by infrared heat sensors. The aircraft hot brake checks will be accomplished prior to entering the hot refueling area. Aircraft with suspected or known hot brakes will not enter the hot refueling pad. The external fuel tanks will be safed prior to entering the hot refueling area.

c. All aircraft systems not essential for the hot refueling operations will be deactivated.

d. The hot refueling supervisor will ensure the fuel servicing equipment outlet nozzle is con nected and the deadman control valve is hand held. The hot refueling supervisor will maintain intercom contact with the pilot and hot refueling crewman plus visual contact with the hot pad supervisor and fuels equipment operator. The hot refueling supervisor will observe the aircrew to ensure they maintain their hands up and/or out of the cockpit instrumentation area.

e. The fuels equipment operator will use standard checklists developed for preoperative inspection check of the fuel servicing equipment. Upon pressurization of the fuel servicing equipment, the equipment operator and all ground crewmen will check the system for malfunction or leaks. If no leaks are detected, the ground crewmen will signal the hot refueling supervisor that fuel transfer can begin.

f. On aircraft equipped with the capability to pre-check the refuel high level shutoff valves, the valves will be pre-checked at the beginning of the hot refueling operation.

WARNING

Malfunction of any component of the fuel servicing equipment is cause to immediately shut down the equipment until the defect is repaired.

g. When the fuel servicing is completed, the aircraft fuel servicing supervisor will advise the pilot that the single point nozzle and bond wire have been disconnected. The aircraft hot refueling supervisor will then marshall the aircraft out of the area.

7-13. EMERGENCY PROCEDURES.

NOTE

Emergency procedures will be out lined in locally developed checklists if such procedures are not included in specific aircraft checklist.

a. Hot refueling operations may take place in HAS, hot refueling pads, or revetment areas. If a fire or fuel leak occurs, the following actions must be initiated immediately:

(1) Stop fuel flow.

(2) Stop aircraft engines.

(3) Notify the fire department.

(4) Evacuate all personnel other than fire guard(s).

(5) If leak: Designated fire guard(s) will stand by with the portable extinguisher nozzle in hand (or nearby to initiate installed system) until the fire department arrives.

(6) If fire: Designated fire guard(s) will attempt to extinguish the fire until the base fire department arrives or until munitions are engulfed in flame.

b. If a fire occurs at another location in the general proximity of the aircraft being hot refueled, the following actions will be initiated at the location without the fire:

(1) Stop fuel flow.

(2) Disconnect fuel nozzle, bond wire and intercom cable.

(3) Evacuate aircraft from the area.

(4) Designated fire guard(s) will assist in fire fighting operations until the aircraft rescue and fire fighting vehicle arrives.

Table 7-1. Integrated Combat Turnaround System Safety Engineering Analyses

SYSTEM	DATE EVALUATED	PREPARING ACTIVITY
F-101B	Mar 77	AFLC
F-4C/D/E/G	May 77	AFLC
F-106A/B	Jun 77	AFLC
F-5E	Dec 77	AFLC
F-15A/B/C/D	Dec 77	AFLC/AFSC
F-105	Feb 78	AFLC
A-7D/K	Apr 88	AFLC
F-111A/D/E/F	Mar 78	AFLC
A-1OA	Apr 78	AFLC/AFSC
B-52D/G/H (Non-nuclear)	May 78	AFLC
F-16A/B/C/D	Dec 78	AFLC/AFSC
RF-4C	Feb 79	AFLC
B-52D/G/H (Accelerated Nuclear Generation)	Oct 80	AFLC
FB-111* (Accelerated Nuclear Generation)	Jul 81	AFLC
F-5A/B/F	Nov 83	AFLC
EF-111A	May 85	AFLC
B-1B (Accelerated Nuclear Generation)	Aug 87	AFLC
F-15E	Jul 89	AFLC
B-52G/H** (Integrated Combat Procedures) (Nuclear) (ICPN)	Jun 90	AFLC
B-1B	Apr 91	AFLC

*Approved for simultaneous fuel servicing and maintenance to be followed by loading of nuclear weapons under TO 1F-111(B)-16

**Fuel servicing equipment operators will be provided with a headset capable of monitoring all intercom communications to expedite a rapid shutdown in the event of an emergency (NUCLEAR ONLY).

NOTE: All fuel sources approved for hot refuelings (Table 7-3) or fuel sources equipped with deadman controls are approved for ICTs. MH-2 series hosecarts are also approved when used in conjunction with a Type I or II fuel hydrant system equipped with a magnetic kiss system.

Table 7-2. Hot Integrated Combat Turnaround System Safety Engineering Analyses

SYSTEM	DATE EVALUATED	PREPARING ACTIVITY
A-10	Aug 80	AFISC
F-16A/B/C/D	Aug 82	AFLC
F-4C/D/E/G	Oct 82	AFLC
F-15A/B/C/D	Oct 82	AFLC
RF-4C	Oct 82	AFLC
F-15E	Jul 89	AFLC

Table 7-3. Hot Refueling System Safety Engineering Analyses

SYSTEM	DATE EVALUATED	PREPARING ACTIVITY	APPROVED/ DISAPPROVED
AIRCRAFT			
A-7D/K (USAF)	Mar 71	AFISC	A
F-4	Jul 76	AFLC	A
F-5A/B	Nov 76	AFLC	D
F-15	Jul 77	AFLC/AFSC	A
A-10	Feb 78	AFLC	A
F-111	May 78	AFLC (SM-ALC)	D
F-16	Dec 78	AFLC	A
E-4B	Apr 83	AFLC	A
C/AC/HC/MC-130	Dec 84	AFLC	A
B-1B	Aug 87	AFLC	A
B-2A	Aug 98	AFMC	A
F-15E	Jul 89	AFLC	A
EA-6 (Navy)	Apr 89	AFLC	A
A-6 (Navy)	Apr 89	AFLC	Pending
A-7 (Navy)	Apr 89	AFLC	A
E-2 (Navy)	Apr 89	AFLC	A
F-14 (Navy)	Apr 89	AFLC	A
F-18 (Navy/Marine)	Apr 89	AFLC	A
S-3 (Navy)	Apr 89	AFLC	A
HU-25 (Coast Guard)	Apr 95	AFMC	A
CASA-235	Mar 96	AFMC	A
Pilatus PC-6	Mar 97	AFMC	A
DeHaviland DHC-6	Mar 97	AFMC	A
Beech King Air	Mar 97	AFMC	A
MV-22	Mar 00	AFMC	A
X-32A	Oct 00	AFMC	A
X-35A/C	Nov 00	AFMC	A
UV-18B[9]	Nov 00	AFMC	A
FUELING SYSTEMS[4]			
Type IV Hydrant System	Jul 76	AFLC	A*
GRU-17/E Pantograph[5]	Apr 77	AFLC	A**
R-5/R-9/R-14/R-25/R-26	Apr 77	AFLC	A*
Type II Hydrant System	Jun 77	AFLC	A*
Type I Hydrant System	Jul 77	AFLC	A*
ABFDS with ACE	Jul 79	AFLC	A
R-14A	Jun 84	AFLC	A**
Type III Hydrant System	Aug 87	AFLC	A*
R-11	Mar 90	AFLC	A**
R-12	Nov 86	AFLC	A***
US Army M-978 HEMTT with HTARS[6]	Apr 92	AFLC	A
MH-2C Hose Cart[8]	Nov 96	AFMC	A**
NVE Millennium Hydrant Hose Cart	Feb 00	AFMC	A
NVE MH-4 Millennium Hydrant Hose Cart	June 00 (Tabletop)	AFMC	A
ARRF (Oasis) ****	Apr 98	AFMC	A
R-14A/C	Feb 01	AFMC	A

Table 7-3. Hot Refueling System Safety Engineering Analyses - Continued

SYSTEM	DATE EVALUATED	PREPARING ACTIVITY	APPROVED/ DISAPPROVED
HELICOPTERS			
CH-53	Sep 79	AFLC	A
HH-1H, UH-1N[1]	Mar 82	AFLC	Pending
HH-3[1,2]	Mar 82	AFLC	A
HH/MH-53[1,3]	Mar 82/Feb 92	AFLC	A
UH-60A/L, HH/MH-60G/J[7]	Dec 84/May 91	AFLC	A
C-27	Oct 91	AFLC	A
Army/Marine AH-1, AH-64, CH-47, OH-58A through D, UH-1, and UH-60.	Jun 85	AFLC	A
HH-65 (Coast Guard)	Apr 95	AFMC	A
CH/HH/UH-46	Aug 94	AFMC	A
Puma	Mar 96	AFMC	A
Wessex	Mar 96	AFMC	A
Lynx	Mar 96	AFMC	A

[1]NOTE: Fuel service includes CH-53 Auxiliary Tanks with Fuel Transfer by US Army FARE system.

[2]NOTE: R-5/R-9 fuel servicing trucks equipped with deadman controls are approved for H-3 hot refueling when using a reduced pumping pressure of 25 psi or less.

[3]NOTE: R-5/R-9 fuel servicing trucks equipped with deadman controls are approved for H-53 hot refueling.

[4]NOTE: Hot refueling and hot ICT operations are no longer authorized when using MIL-H-6615 refueling hose and/or MIL-C-38404 hose end couplers. Approved replacement hose to continue these operations is API Bulletin 1529, Grade 2/3, Type C,aviation fueling hose. Approved coupling replacements are internally expanded non-reusable hose end couplings meeting the design and performance specifications of API Bulletin 1529. (Exception to this requirement is hot refueling of E-4B aircraft due to distance between operating aircraft engine and single point refueling (SPR) receptacle locations.)

[5]NOTE: Position the GRU-17/E so that no portion of the pantograph is forward of any aircraft engine inlet during hot refueling or hot ICTs of any aircraft (except A-10 where it can be under the wing).

[6]NOTE: US Army M-978 Heavy Expanded Mobility Tactical Truck (HEMTT) with HEMTT Tanker Aviation Refueling System (HTARS) using lightweight hose is approved for use only with the HELICOPTERS listed as approved under the SYSTEM column in this table.

[7]NOTE: Hot refueling of the Internal Auxiliary Fuel tank system (IAFTS) or the aircraft using the open port/over-the-wing method is not authorized.

[8]NOTE: Must be equipped with a modified CLA-VAL rate-of-flow control valve to act as a hydraulic deadman.

[9]NOTE: Must use only the aft filler port. The forward port is too close to the propeller. Users must make sure that center-of-gravity limitations are not exceeded when refueling only the aft tank.

*Approved for use with any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

**Approved for use when equipped with minimum American Petroleum Institute (API) Bulletin 1529, Type C, Grade 2, hardwall aviation servicing hose assemblies with internally expanded forged brass or bar stock body couplings and brass or 300 Series stainless steel serrated ferrules, respectively.

***Approved for use with pantograph and approved for hot refueling the E-4B and B-1B aircraft only without the use of a pantograph.

**** Aircraft Rapid Refueling Facility (Oasis) located at Ft. Drum NY is approved for use.

7-14. PART II, AIRCRAFT TO AIRCRAFT REFUELING (HOT OR COLD).

7-15. Aircraft to aircraft ground refueling operations may be accomplished with or without the aircraft engines operating for combat, simulated combat, and training operations. This procedure permits the rapid refueling of aircraft or helicopters in a tactical, forward operating area. These operations also provide a means of fueling an aircraft where appropriate fuel is not available (i.e., JP-7 fuel for senior crown aircraft). Fuel is supplied from aircraft internal fuel tanks with pumps powered by ground power units, aircraft power units, or operating aircraft engines. These operations present hazards which are not normally encountered in other fueling operations. Personnel involved in these operations must have:

a. A thorough knowledge of the aircraft fuel systems and fueling equipment used in the operation.

b. A thorough knowledge of and observe all safety procedures.

c. A thorough knowledge of and follow the sequential steps for the operation.

d. Undergone certification per command directives.

7-16. **HOT (ENGINES RUNNING).**

7-17. Aircraft to aircraft ground refueling will not be performed unless aircraft technical order guidance, checklists, and appropriate fueling system checklists are available. Aircraft will not be fueled without qualified and certified personnel. Servicing crew members include aircrews and/or ground support personnel. These operations will not be performed until SSEA validated and approved procedures have been accomplished on the aircraft, fueling system, and support equipment. The SSEA requires HQ AFMC/SES approval. Refer to table 7-4 for these aircraft and fuel systems that have been approved for aircraft to aircraft fueling operations. Any deviation from this policy will be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of aircraft to aircraft refueling, the MAJCOM commander(s) may authorize deviations from this policy. Refer to table 4-1 for fire protection requirements.

7-18. Each MAJCOM involved in aircraft to aircraft ground refueling will publish directives regarding specific procedures for accomplishing the operation. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM is required. A MAJCOM certification team, composed of safety, fuel servicing (when appropriate), aircraft maintenance (when appropriate), operations, fire protection and liquid fuels engineering (when appropriate) will certify individual installations for these servicing operations on a case by case basis. An onsite evaluation is not always required. Specific items to be included in the MAJCOM Directive are:

a. Procedures for certifying the site to be used for the fueling operation.

b. Procedures for certifying and training personnel involved in the fueling operation.

c. Defined responsibilities of various functional agencies to include establishment of the MAJCOM office of primary responsibility (OPR).

d. Other information necessary to assure a successful fueling operation is accomplished. Other information necessary to assure a successful fueling operation is accomplished.

Table 7-4. Aircraft to Aircraft Refueling System Safety Engineering Analyses

PROVIDER	RECEIVERS	DATE EVALUATED	PREPARING ACTIVITY
C-5A/B	H-1	Dec 79	AFLC
C-130*	C-130*	Sep 83	AFLC
(MC, HC)	(MC, HC)		
	H-1	Mar 82	AFLC
	H-3*		
	H-53*		
	UH-60A/L*, HH/MH-60G*	Dec 84/May 91	AFLC
	Army helicopters approved for hot refueling	Jun 85	AFLC
C-141*	C/HC/MC-130*	Sep 83	AFLC
	H-1	Mar 82	AFLC
	H-3*		
	H-53*		
	UH-60A*/L*, HH/MH-60G*	Dec 84/May 91	AFLC
	Army helicopters approved for hot refueling	Jun 85	AFLC
H-53*	H-1	Mar 82	AFLC
	H-3*		
	H-53*		
	UH-60A/L*, HH/MH-60G*	Dec 84/May 91	AFLC
	Army helicopters approved for hot refueling	Jun 85	AFLC
KC-135Q*	KC-135Q	Feb 77	AFLC
KC-135A*	KC-135A	Feb 77	AFLC
KC-135Q*	KC-135Q Senior Crown (JP-7)	Feb 77	AFLC
KC-10*	KC-10 Senior Crown (JP-7) KC-135Q Senior Year (JPTS)	Mar 84	AFLC
KC-135Q*	KC-135Q Senior Year (JPTS)	Feb 77	AFLC
B-1B*B-1B*	Aug 87	AFLC	
C-130N/P*	H-3*	Sep 86	AFLC
(Drogue)	(Probe)		
KC-135D/E/R*	KC-135D/E/R	Redesignation of KC-135A due to engine modifications.	
KC-135T	KC-135T Senior Crown Senior Year	Redesignation of KC-135Q due to engine modifications.	
EC/RC-135*	EC/RC-135	Covered by SSEAs accomplished for KC-135A	
CASA 12*	Aircraft approved for hot refueling (See Table 7-3)	Oct 88	AFLC
CASA 235*	Receiver approved for hot refueling (See Table 7-3)	Oct 98	AFMC

*Engines may be operating.

NOTE: An R-5/R-9/R-11 fuel servicing vehicle equipped with a deadman control may be used as a fuel source/receiver during training sessions for operations involving aircraft other than SAC Tankers (KC-135 Series and KC-10).

NOTE: C-5A/B aircraft may be used to cold refuel US Army helicopters.

Table 7-4. Aircraft to Aircraft Refueling System Safety Engineering Analyses - Continued

PROVIDER	RECEIVERS	DATE EVALUATED	PREPARING ACTIVITY

NOTE: C-130, C-141, and H-53 aircraft may be used to hot refuel US Army helicopters approved by the US Army for hot refueling.

NOTE: R-5/R-9/R-11 fuel servicing trucks equipped with deadman controls are only approved for H-3 and H-53 hot refueling when using a reduced pumping pressure of 25 psi or less.

NOTE: 135 series aircraft are not authorized to run APU(s).

NOTE: A Forward Area Manifold (FAM) cart may be used between any approved provider aircraft and any approved receiver aircraft provided the servicing hoses are fully extended in all directions.

7-19. Wet wing defueling is a similar operation for providing fuel in a forward operating area. Rather than an aircraft or helicopter as the receiver, fuel is transferred into US Army Forward Area Refueling Equipment (FARE), Army tank truck, or 500 gallon sealed drums at a fuel system supply point. This operation provides the rapid supply of fuel needed for initial support of intense short duration conflicts and is accomplished with four aircrew members. Personnel involved will be trained and certified as required by MAJCOM directives. The US Army will furnish all required fuel transfer equipment (including the interface equipment between the aircraft and the US Army fuel system supply point). Fire protection (Army supplied) for the operation is, as a minimum, four dry chemical fire extinguishers of 80 BC rating. For C-5 aircraft, wet wing defueling is accomplished using electrical power from either a USAF-supplied ground power unit (GPU) or the aircraft auxiliary power unit (APU). For C-130 aircraft, electrical power is supplied from either a GPU or by running number 1 and 2 engines. For C-141 aircraft, electrical power is supplied from either a GPU or the aircraft APU. For KC-135E aircraft (after TCTO 1388, 180L APU), electrical power can be supplied from either a GPU, by running an outboard engine, or the 180L APU. Refer to table 7-5 for aircraft approved for wet wing defueling.

7-20. **PART III, FUELS SERVICING USING THE AERIAL BULK FUELS DELIVERY SYSTEM (ABFDS) WITH ALTERNATE CAPABILITY EQUIPMENT (ACE).**

7-21. Aerial bulk fuel delivery systems that are equipped with filter separators, dispensing hoses, fuel nozzles and hose end pressure regulators, ACE, are permitted to service aircraft directly from the cargo aircraft (C-130, C-141 or C-17). The normal fuel servicing members involved in this operation are two 2F0X1 fuel specialists accompanying the fuel system, and certain aircrew members from the cargo (tanker) aircraft. Procedures for this operation are provided in aircrew checklists and TO 37A9-3-11-1CL-1. Use of this equipment is restricted to combat, simulated combat, and training operations as directed by the MAJCOM. These operations will not be performed until SSEA evaluated and approved procedures have been accomplished on the aircraft, fueling system, and support equipment. The SSEA requires HQ AFMC/SES approval. Refer to table 7-6 for those aircraft that have been approved for hot ABFDS with ACE fueling operations. Any deviation from this policy shall be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of ABFDS with ACE to aircraft refueling, the MAJCOM commander(s) may authorize a deviation from this policy. Refer to table 4-1 for fire protection requirements. Personnel performing this operation must have:

1. A thorough knowledge of the aircraft and fuels servicing equipment involved in the operation.

2. A thorough knowledge of and follow all safety procedures.

3. A thorough knowledge of and follow the sequential steps of the operation.

4. Undergone certification per command directives.

7-22. Each MAJCOM involved in ABFDS with ACE to aircraft ground refueling will publish directives regarding specific procedures for accomplishing the operation. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM commander is required. A copy of each MAJCOM commander's approval will be furnished to HQ USAF/LGSSF and the aircraft system manager/director. Specific items to be included in the MAJCOM directives are:

a. Procedures for certifying and training personnel involved in the fueling operation.

b. Defined responsibilities of various functional agencies to include establishment of the MAJCOM office of primary responsibility (OPR).

c. Any other information necessary to assure a successful fueling operation is accomplished.

Table 7-5. Wet Wing Defueling System Safety Engineering Analyses

PROVIDER	RECEIVERS	DATE EVALUATED	PREPARING ACTIVITY
C-5A/B	US Army FARE/Truck/Drum	Mar 81/Nov 79	AFLC
C-130	US Army FARE/Truck/Drum	Mar 81/Nov 79	AFLC
C-141	US Army FARE/Truck/Drum	Mar 81/Nov 79	AFLC
C-27	US Army FARE/Truck/Drum	Oct 91	AFLC
KC-10	R-14/US Army FARE	Nov 93	AMC
KC-135	R-14/US Army FARE	Nov 93	AMC

Table 7-6. ABFDS with ACE Refueling System Safety Engineering Analyses

PROVIDER AIRCRAFT	RECEIVER AIRCRAFT	HOT	COLD
C-130/C-141/C-17 ABFDS with ACE Equipped Aircraft (These aircraft may have their engines operating)	H-1		X
	H-3	X	X
	H-53	X	X
	F-15		X
	A-10		X
	C-141		X
	C/HC/MC-130	X	X
	UH-60A/L*, HH/MH-60G*	X	X
	Army helicopters approved for hot refueling	X	X

*UH-60A/L and HH/MH-60G helicopters are not authorized to hot refuel the Internal Auxiliary Fuel Tank System (IAFTS) or the aircraft using the open port/over-the-wing method.

Table 7-7. Hot Defueling System Safety Engineering Analyses

SYSTEM	DATE EVALUATED	PREPARING ACTIVITY	APPROVED/DISAPPROVED
KC-10	Mar 84	AFLC	A
C-27	Oct 91	AFLC	A